

Fig. 1

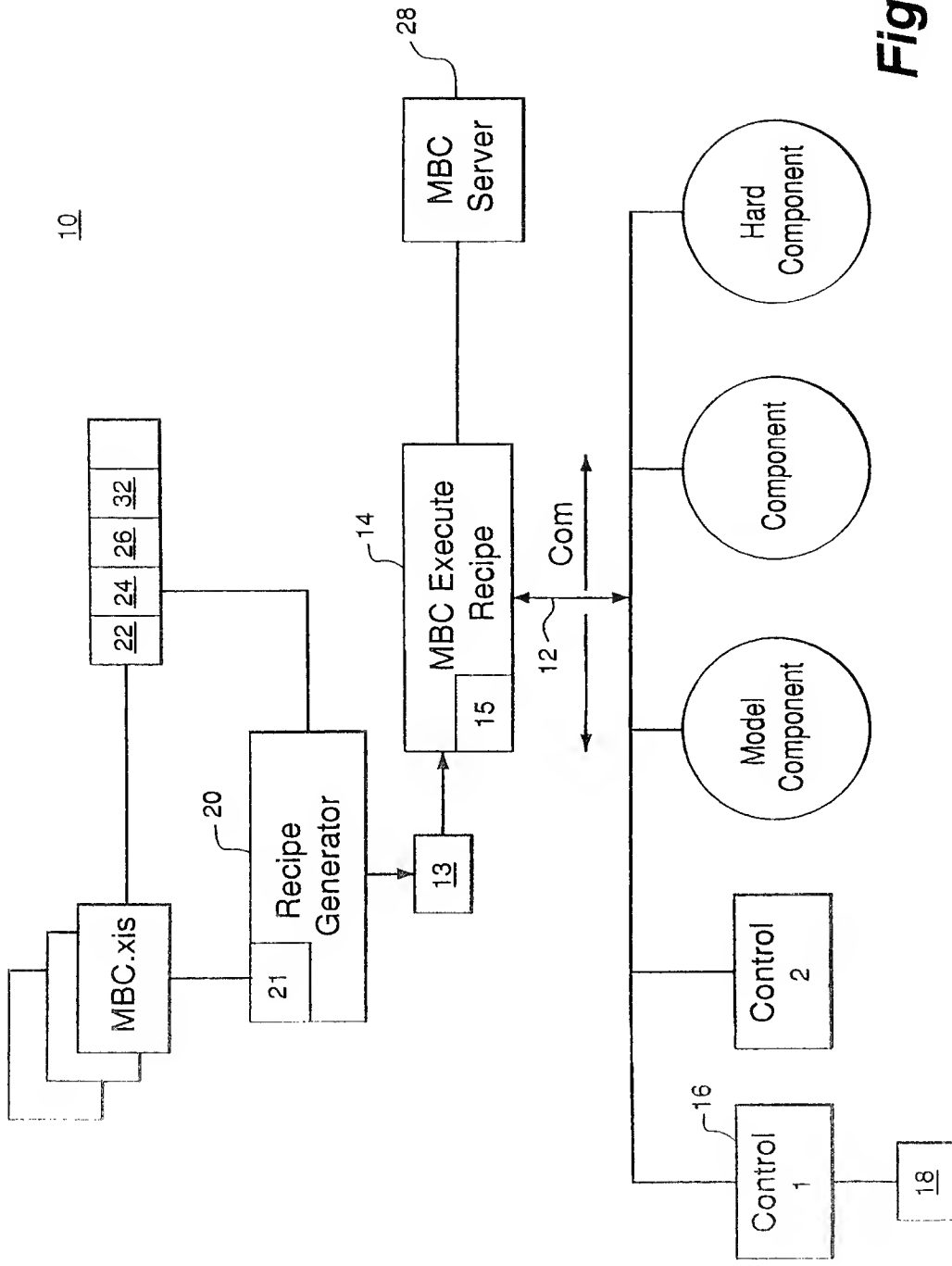


Fig. 2

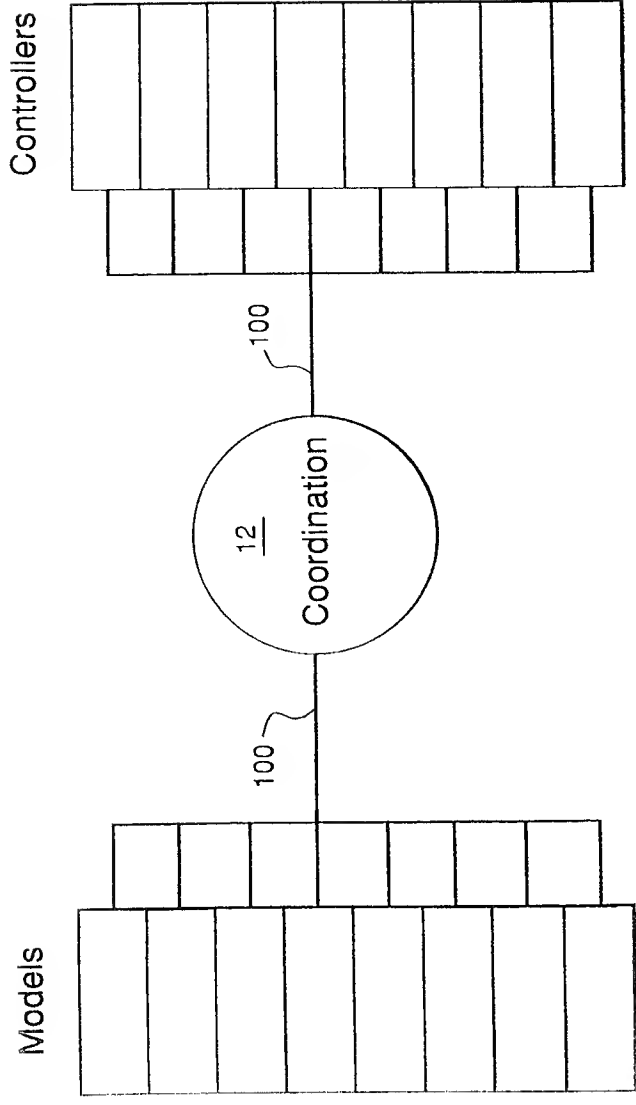
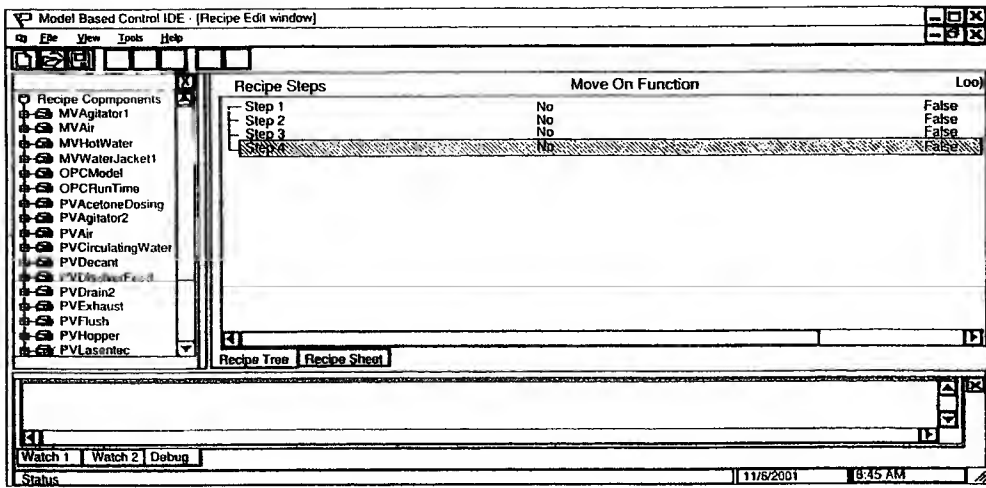


Fig. 2A



Recipe Edit Window

| Recipe Steps | Move On function | Loop | LoopTime | StepTime |
|--------------|------------------|-------|----------|----------|
| Step 1 | No | False | 10 | 100 |
| Step 2 | No | False | 0 | 0 |
| Step 3 | No | False | 0 | 0 |

Recipe Tree | Recipe Sheet

Recipe Step Detail

Step No: Description:

☒ Pre-Process Step

☒ Post-Process Step

Component Commands

A

V

+

-

Loop Control

Move On:

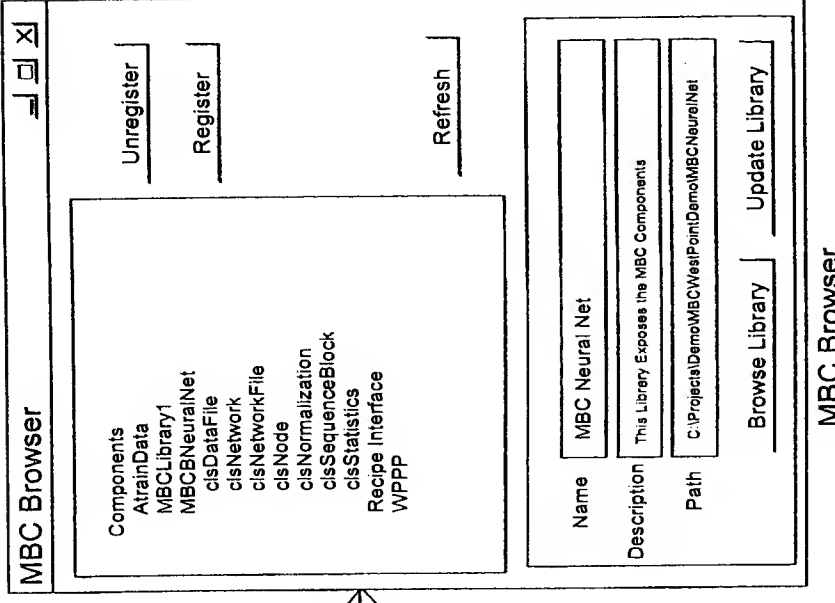
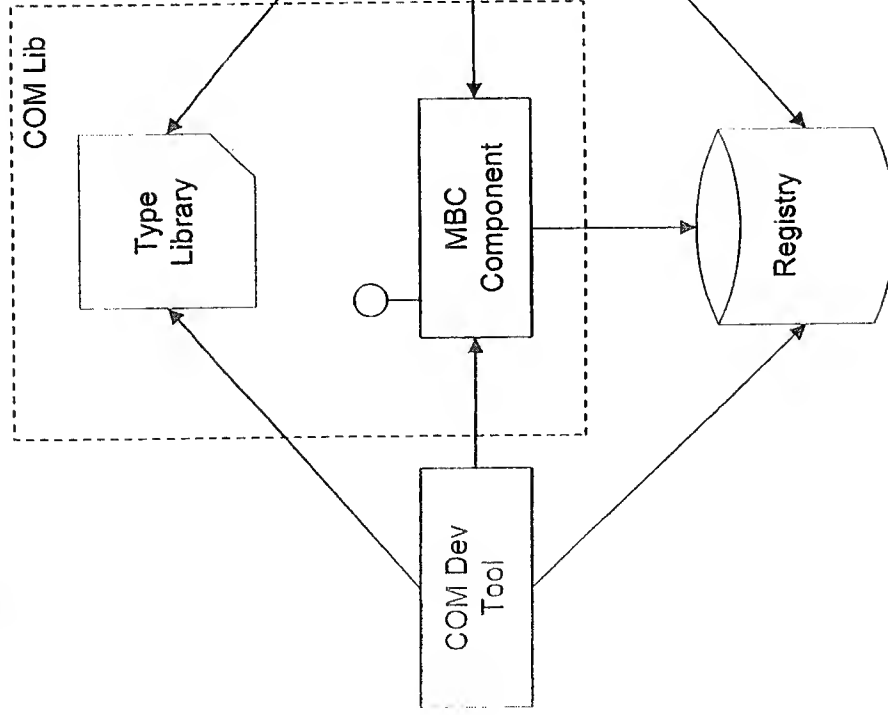
Loop Time:

Step Time: Units: ☒

First Prev Next Last

Fig. 3

Fig. 4



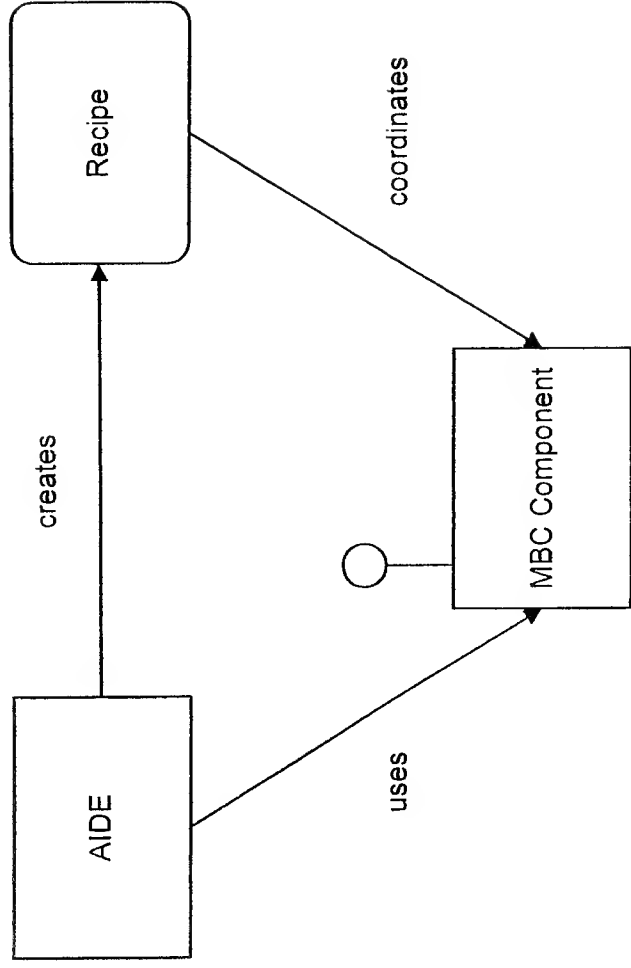
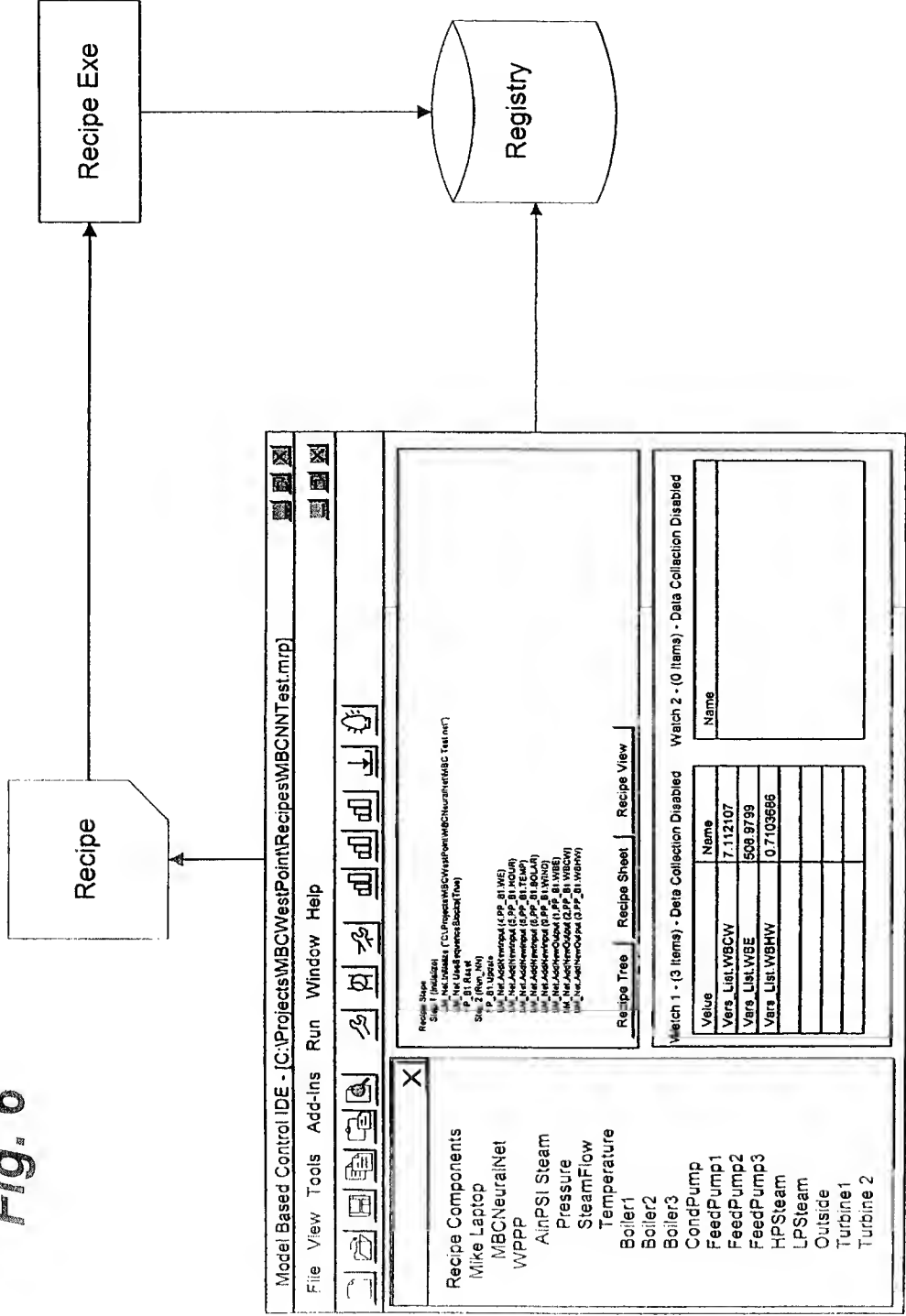


Fig. 5

Fig. 6



AIDE

Fig. 7

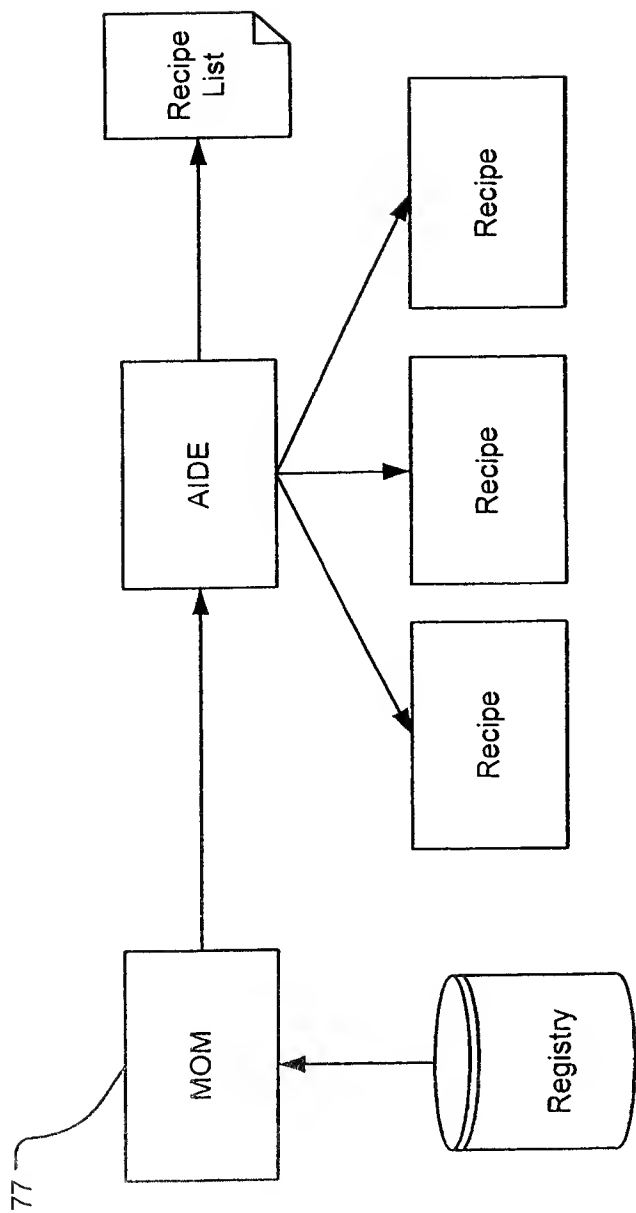


Fig. 8

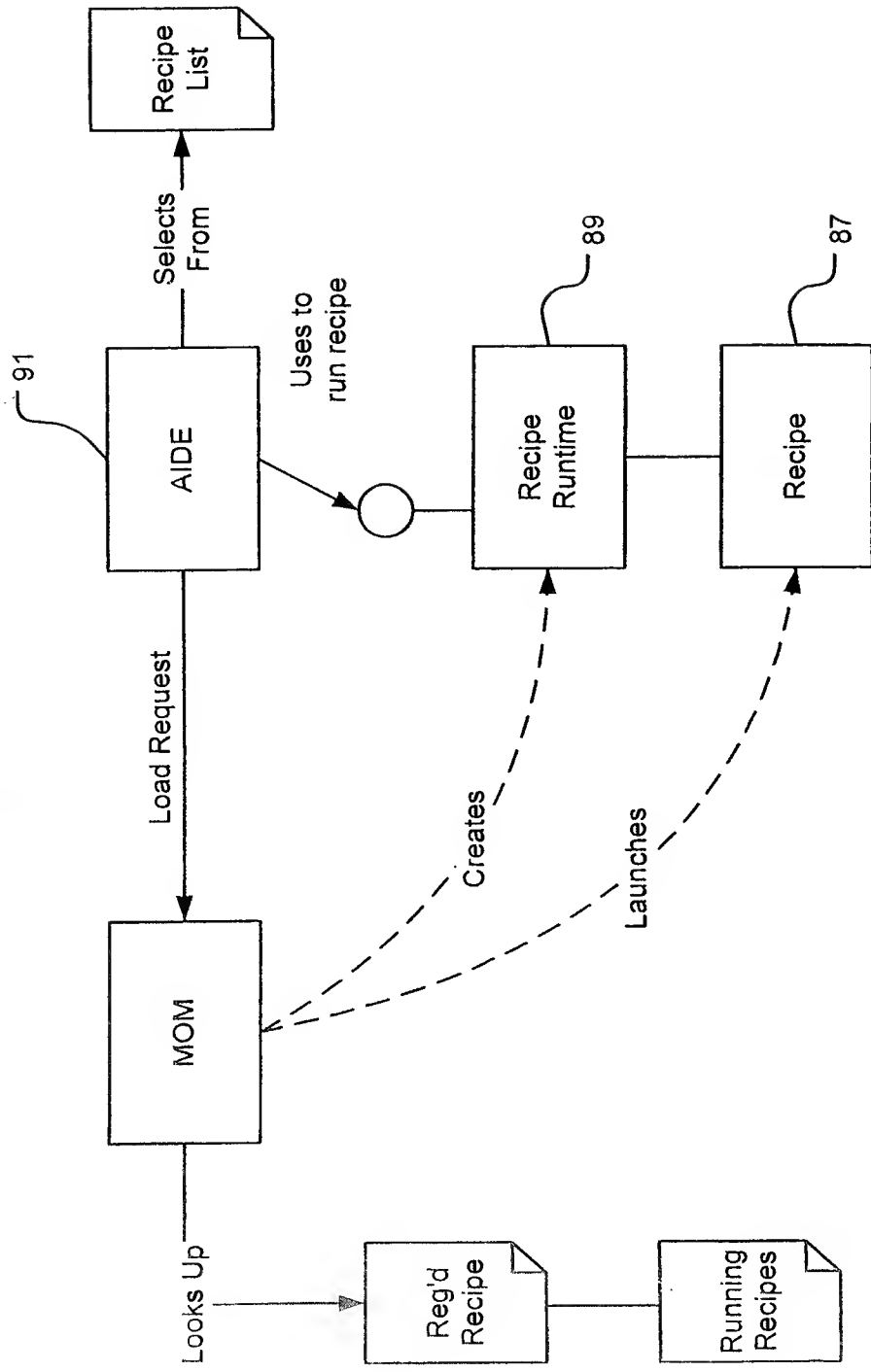


Fig. 9

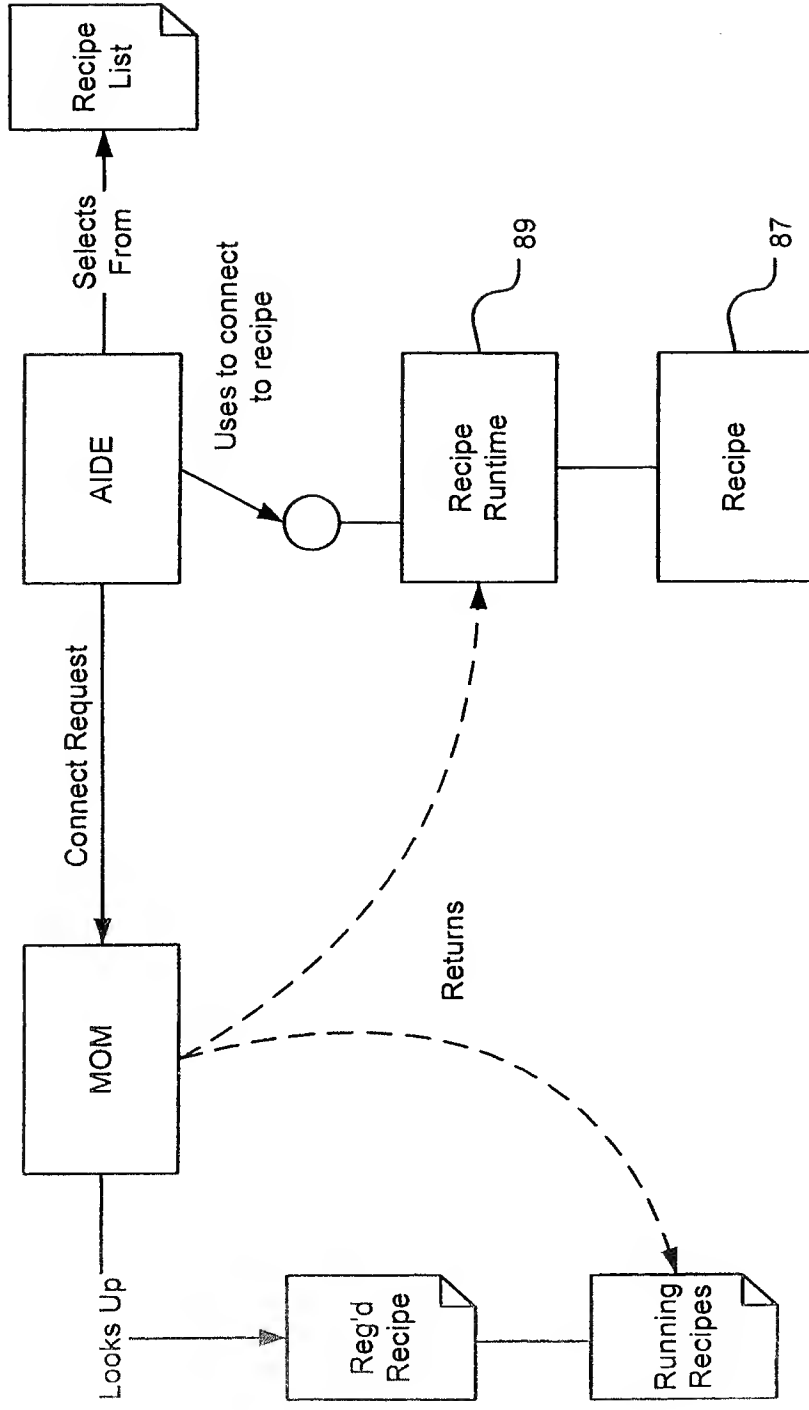


Fig. 10

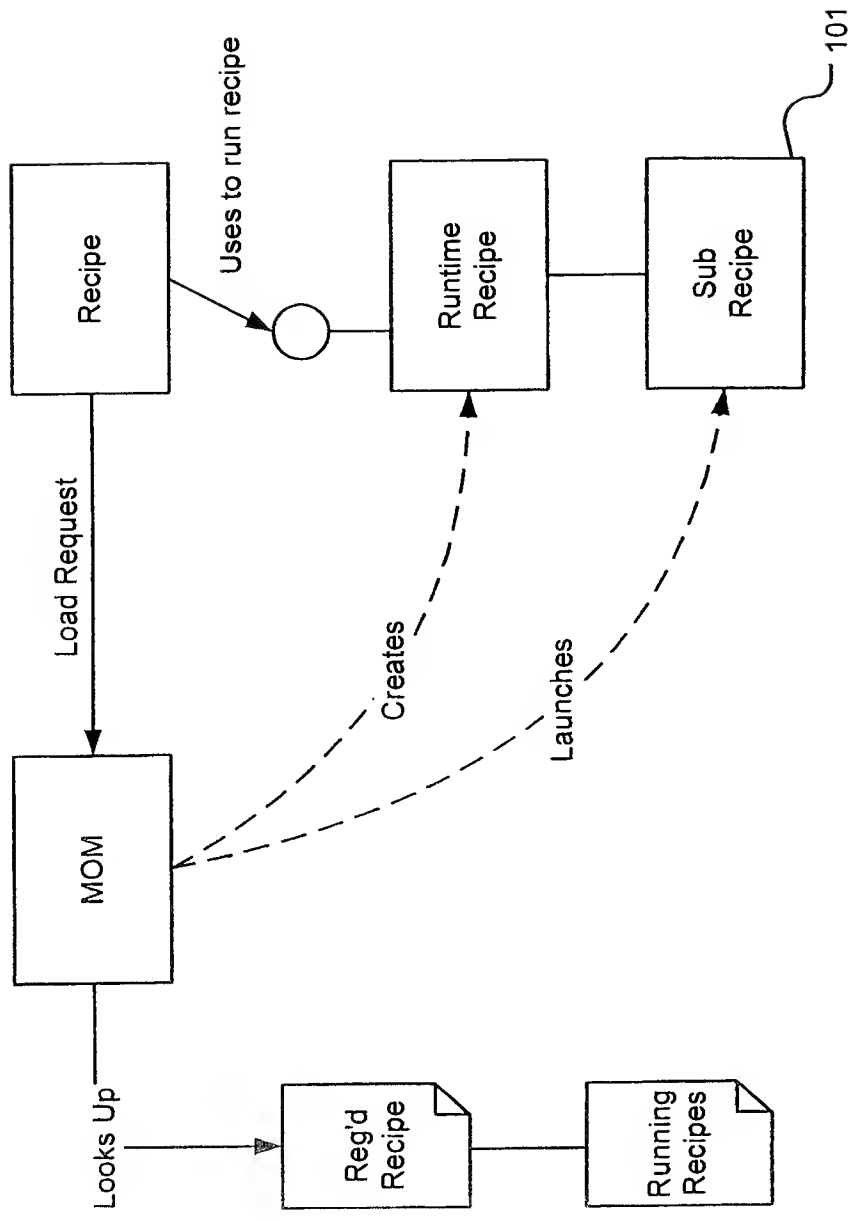


Fig. 11

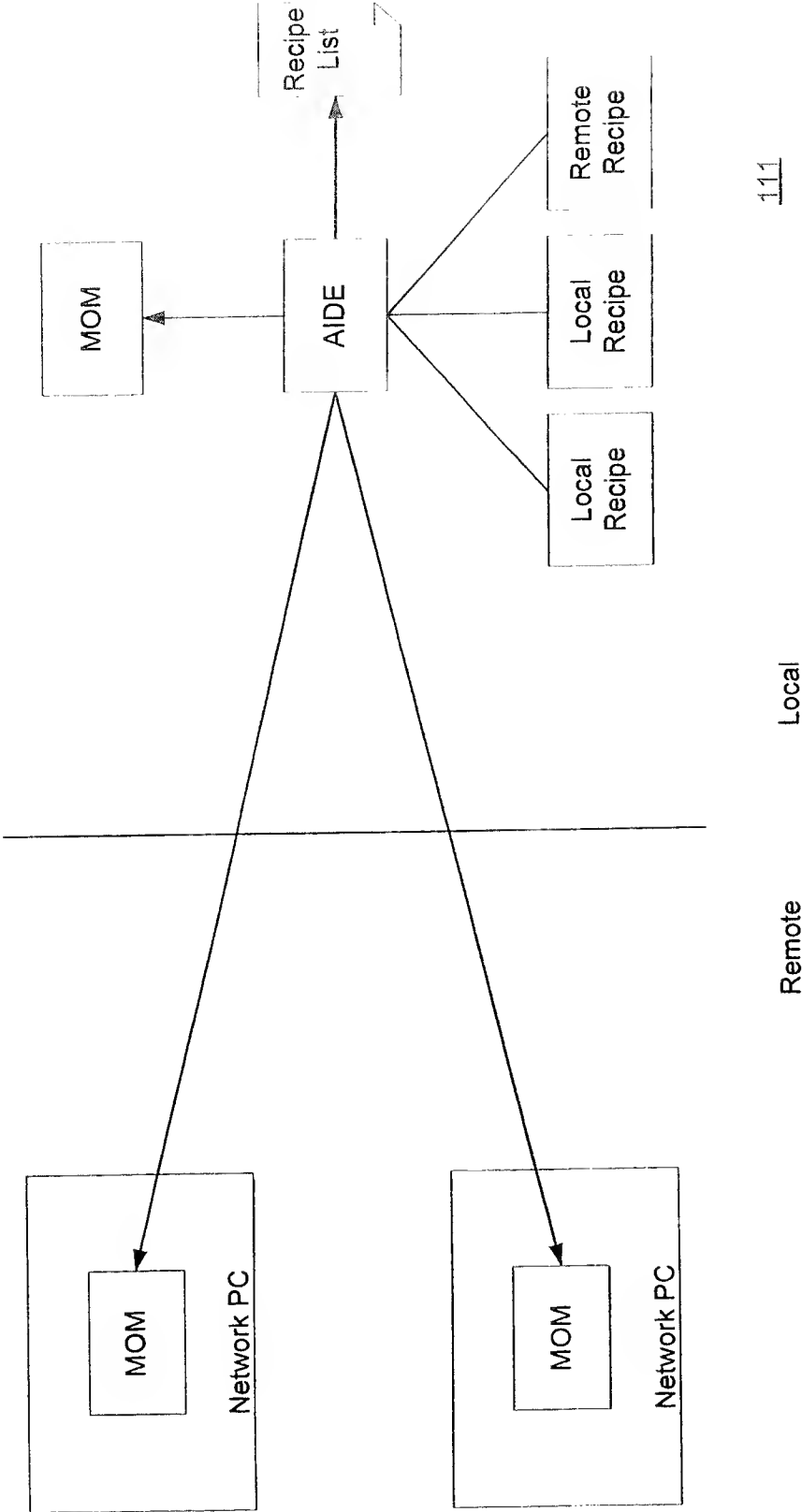


Fig. 12

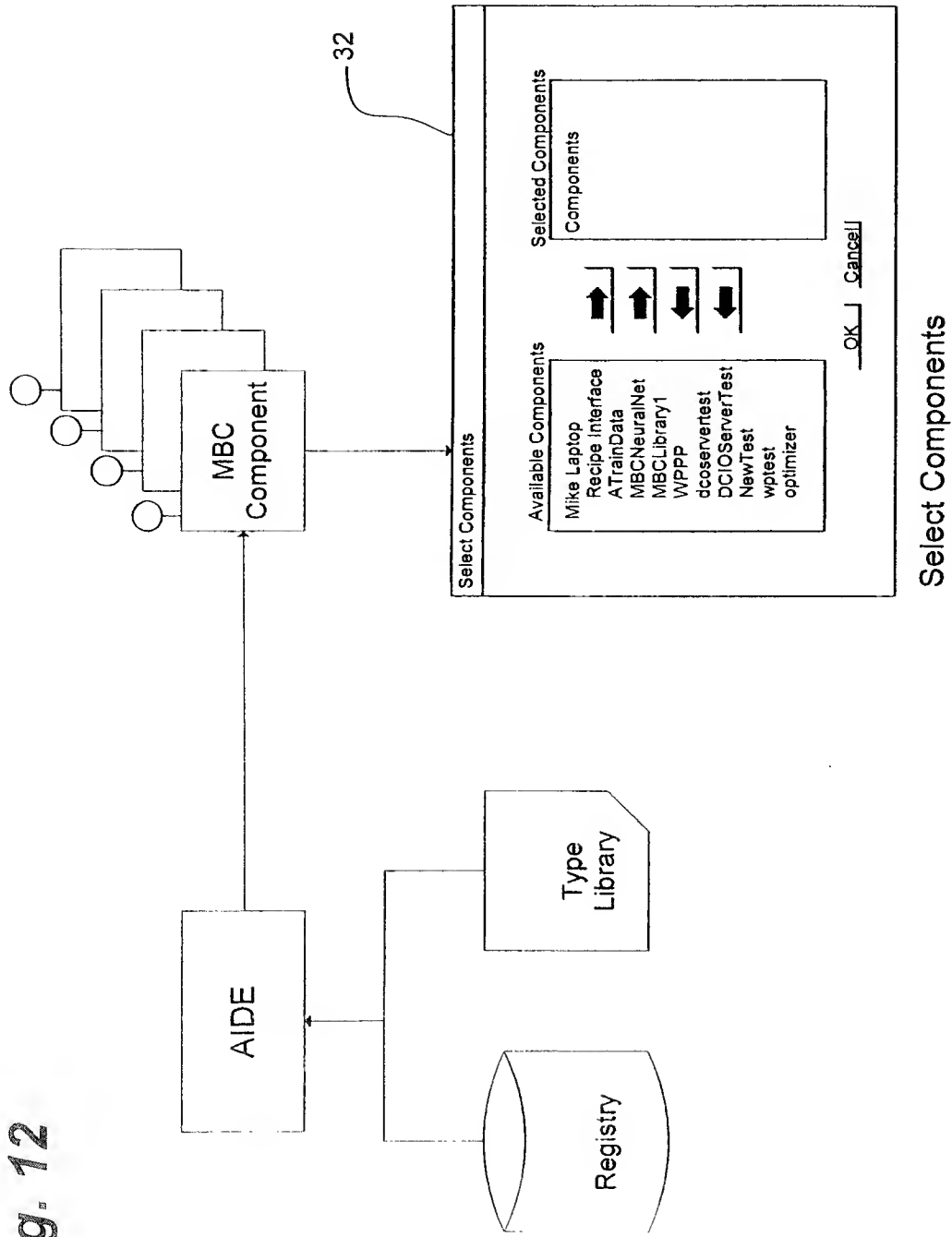


Fig. 13

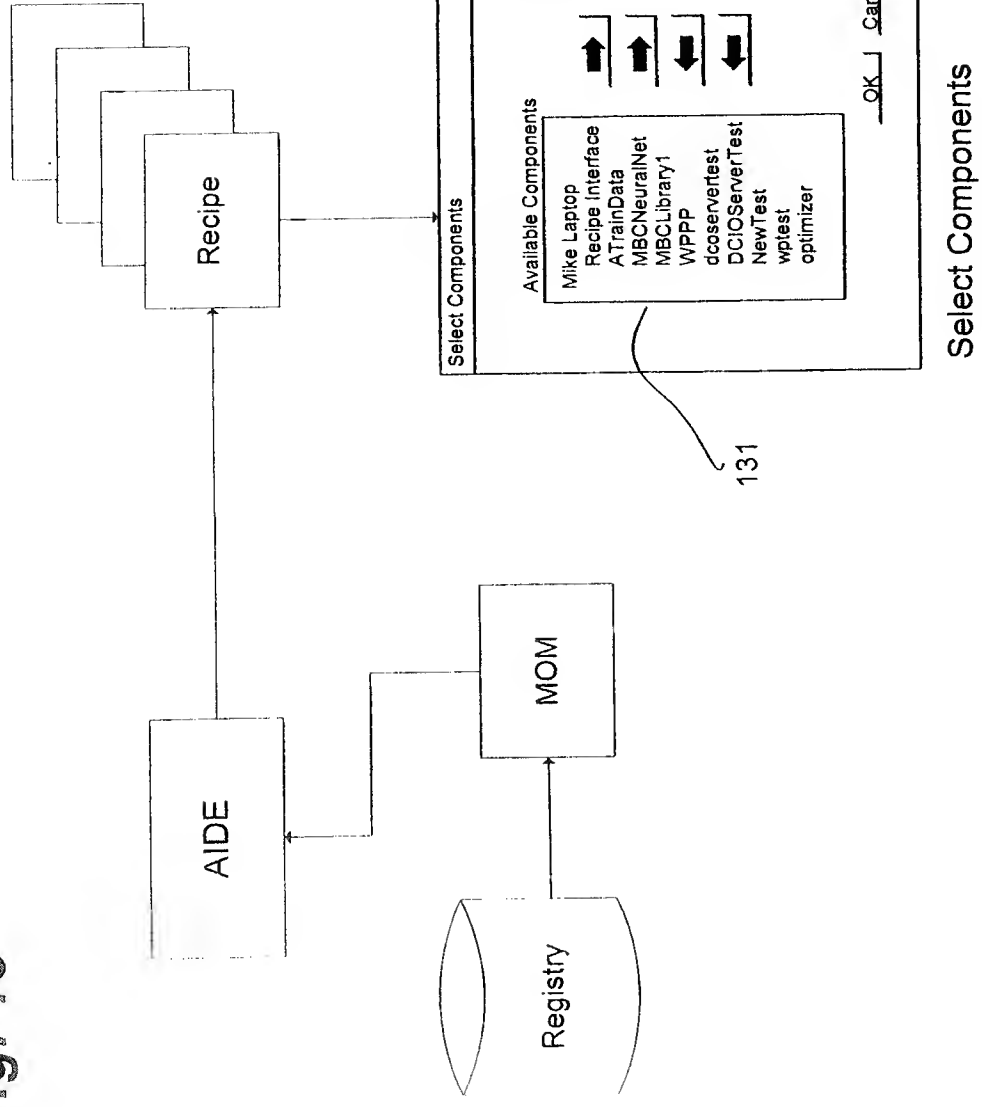
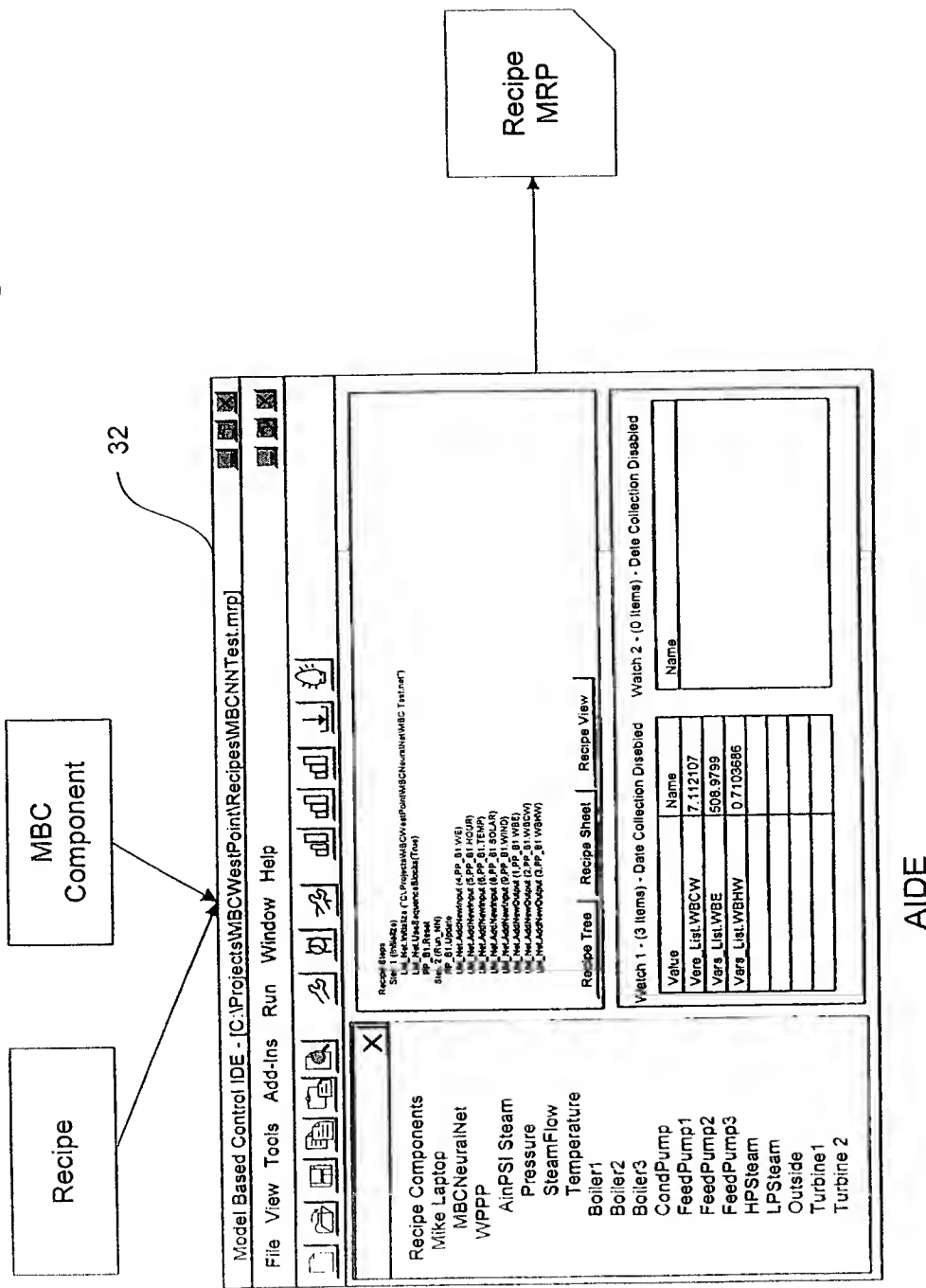


Fig. 14



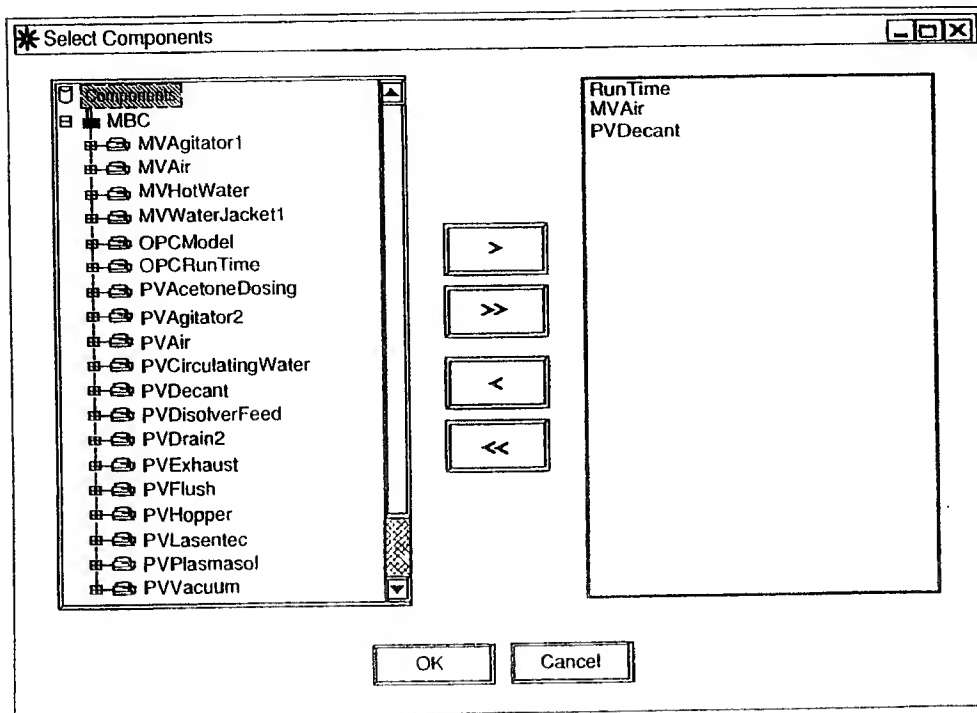
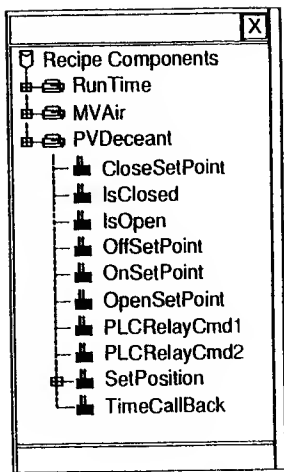
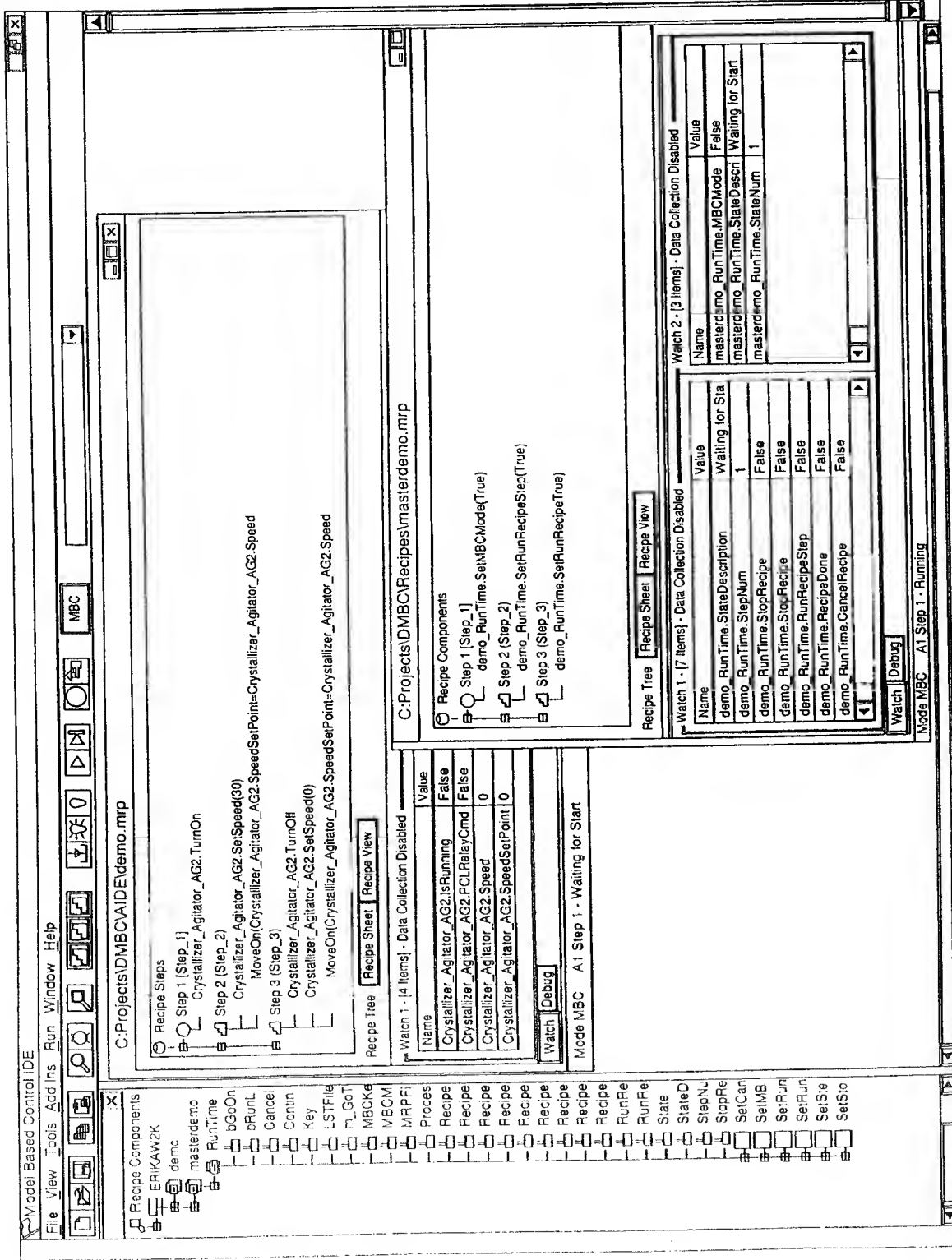


Fig. 15



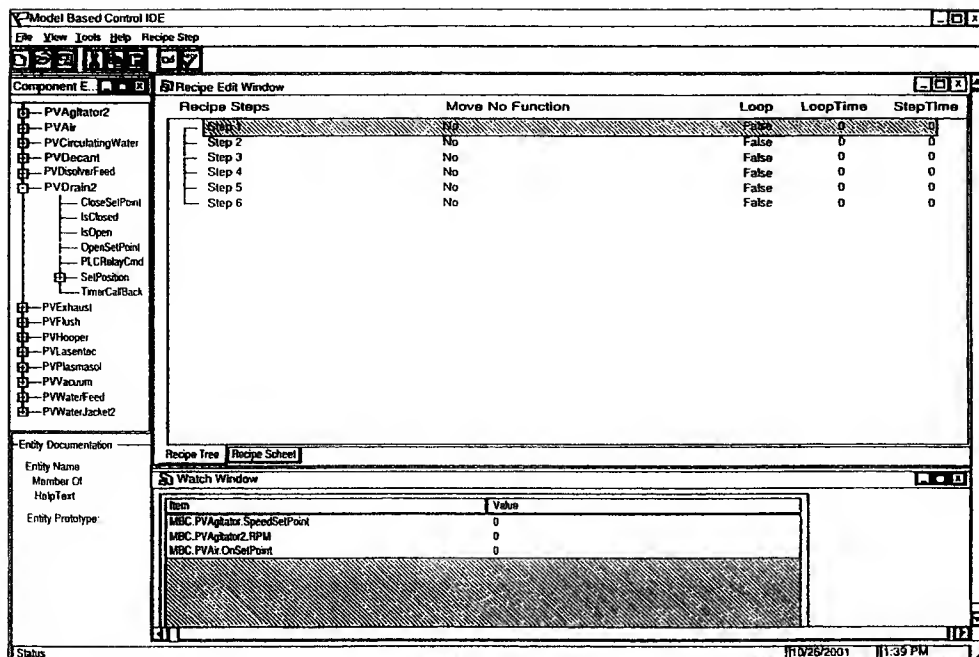


Fig. 17

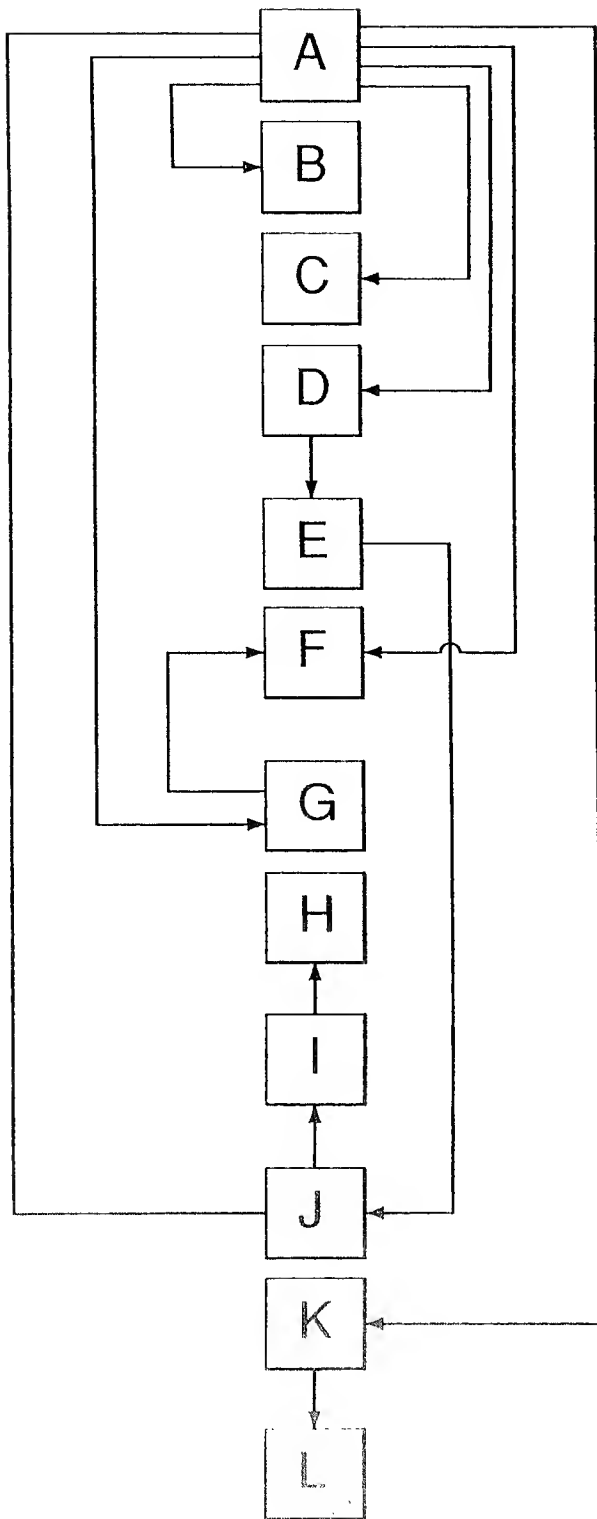


Fig. 18

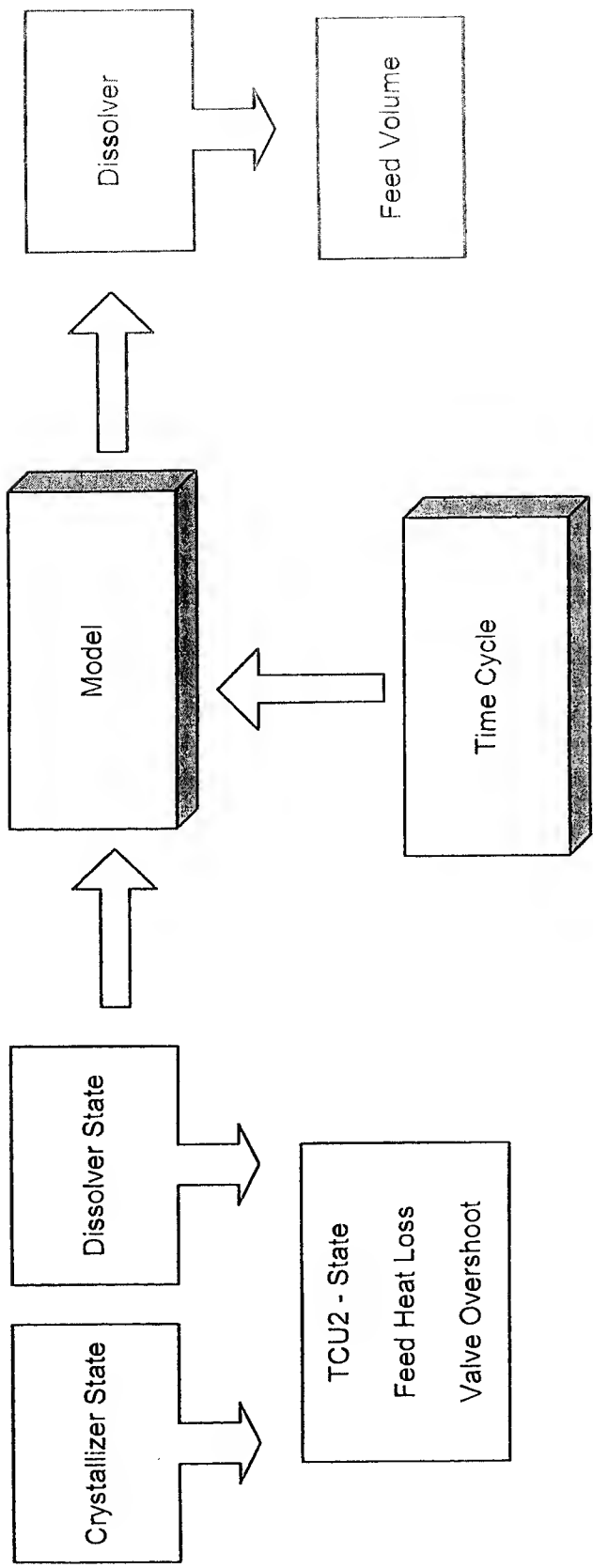
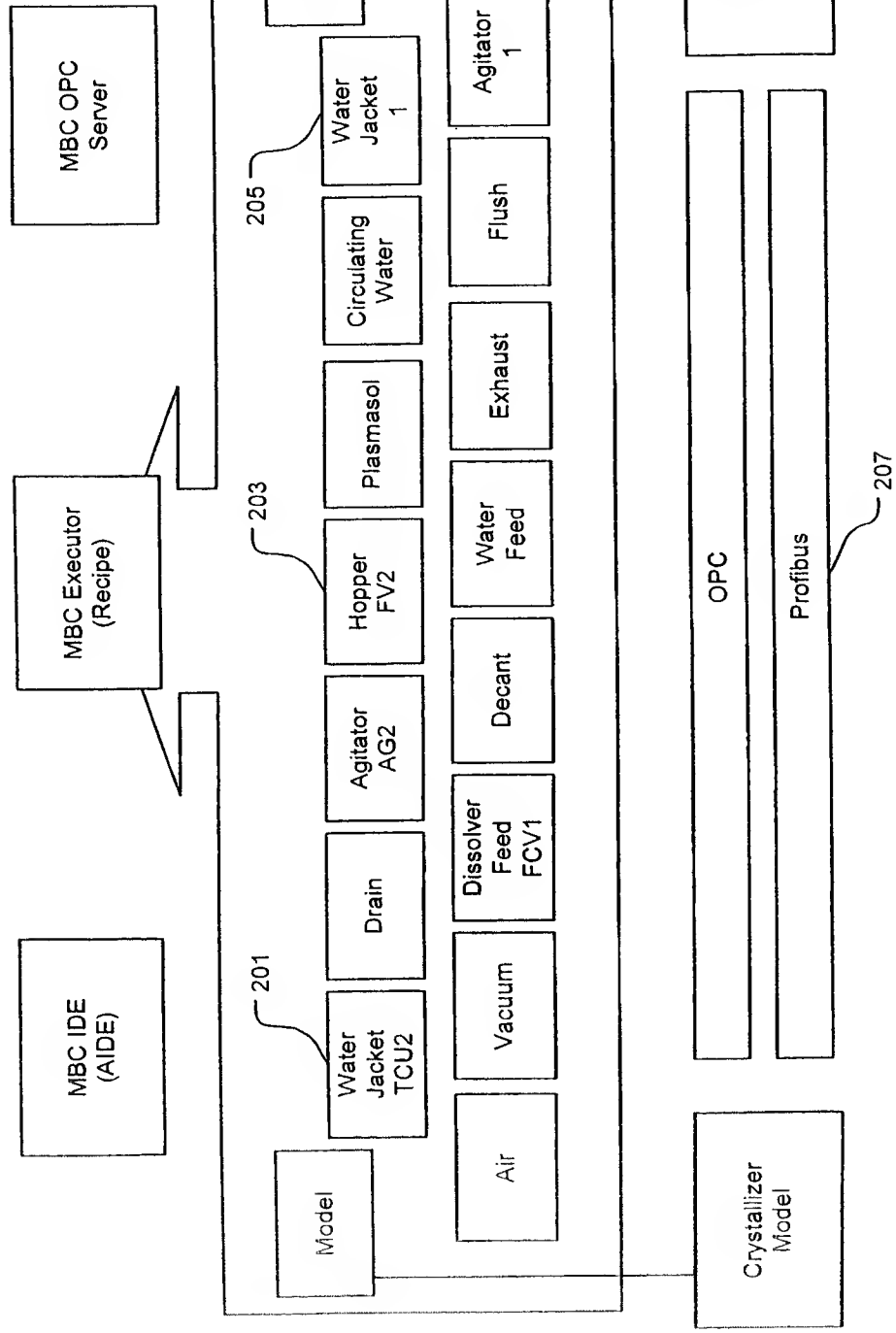


Fig. 19

Figure 1 is a block diagram of the overall system architecture. The diagram shows a central 'Crystallizer Model' block connected to a 'Model' block and a 'MBC IDE (AIDE)' block. The 'MBC IDE (AIDE)' block is connected to an 'MBC Executor (Recipe)' block, which in turn is connected to an 'MBC OPC Server' block. The 'MBC Executor (Recipe)' block is also connected to a large 'Process Control' block. This block contains several sub-blocks: 'Water Jacket TCU2', 'Drain', 'Agitator AG2', 'Hopper FV2', 'Plasmamol', 'Circulating Water', 'Water Jacket 1', 'Air', 'Vacuum', 'Dissolver Feed FCV1', 'Decant', 'Water Feed', 'Exhaust', 'Flush', and 'Agitator 1'. The 'Process Control' block is connected to an 'OPC' block and a 'Profibus' block, which are both connected to a 'Crystallizer Model' block.



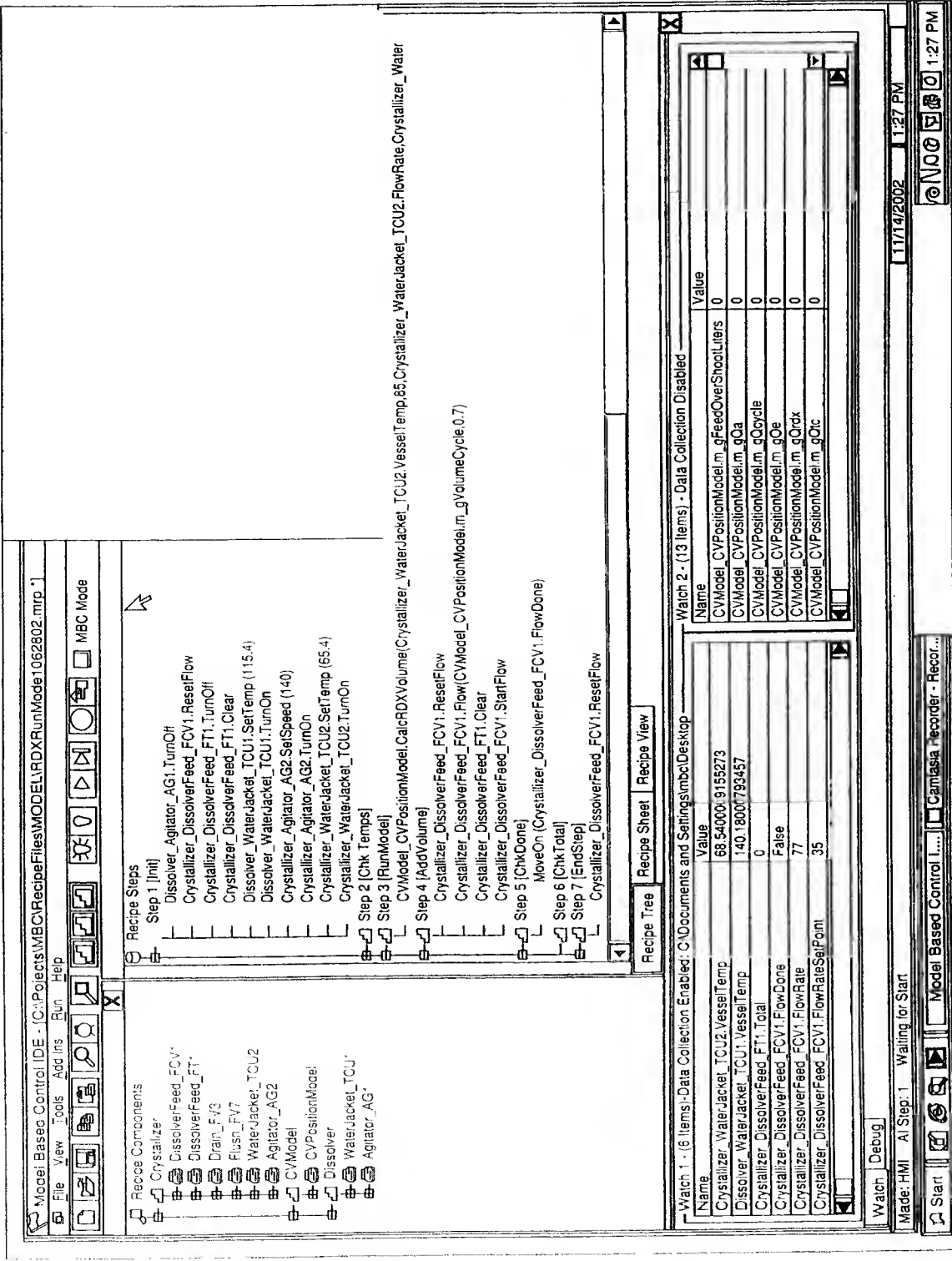


Fig. 21

Fig. 22

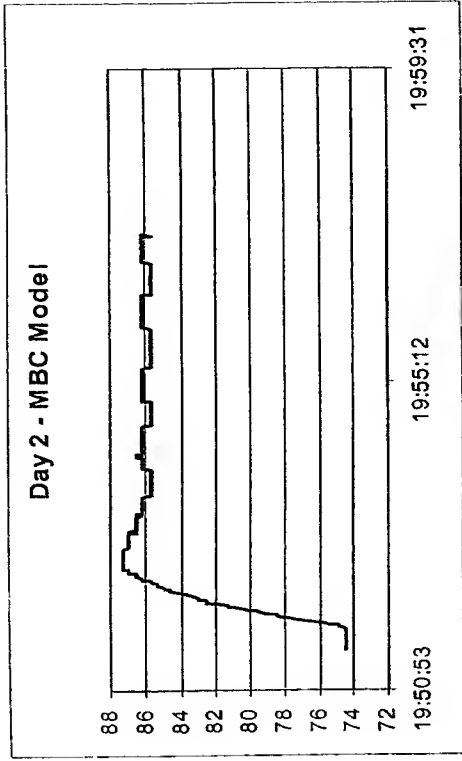
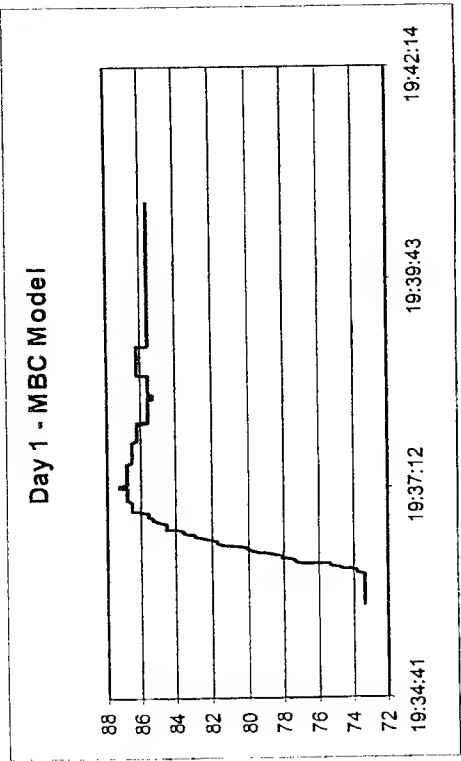
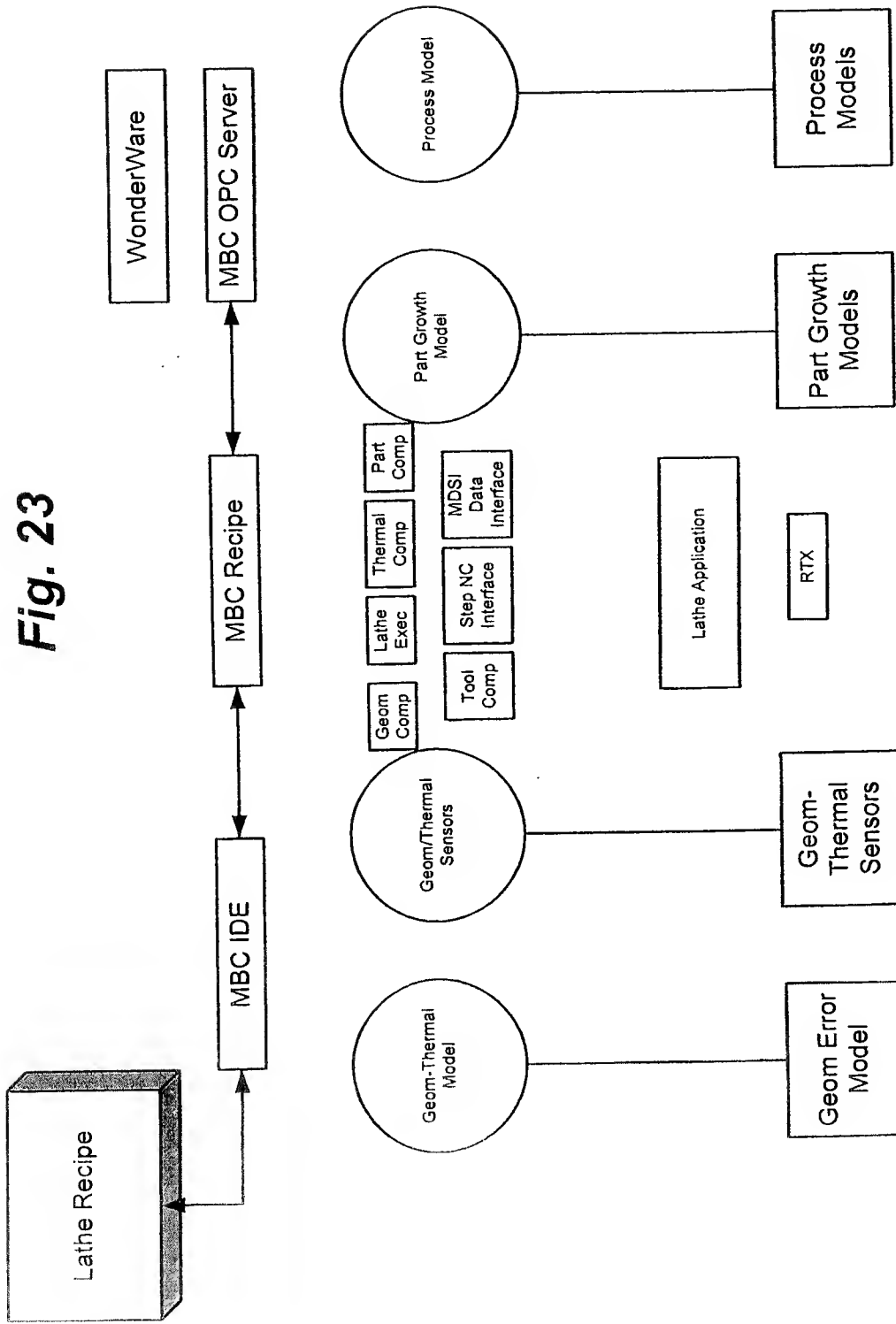


Fig. 23



Recipe View File Edit Recipe Window Help

Recipe Name
C:\Projects\MBC\Data\recipe First shot - Dave.xls

Recipe State
Waiting for Start

Date/Time
Wednesday, October 24, 2001 - 10:13:14 A

Recipe Step
1

Total Steps
6

Step Time
0

Total Time
0

Recipe Done
False

Keep Alive
True

Move On Function
MVWaterJacket1.Temp >= 58 And PVAgit

Loop
False

Loop Time
1000

Step Time
60000

Recipe Step Commands

```
PVAgitator2.SetPosition ("On")
PVAgitator2.SetSpeed (80)
PVWaterJacket2.SetPosition ("On")
PVWaterJacket2.SetTemp (30,1)
PVHopper.SetPosition ("Open")
MVAgitator1.SetPosition ("On")
MVWaterJacket1.SetPosition ("On")
MVWaterJacket1.SetTemp (58,1)
```

Recipe Step Code

```
Step 1
binGoOn = False
binRunLoop = True
Do
  If binRunLoop Then
    Call PVAgitator2.SetPosition ("On")
    Call PVAgitator2.SetSpeed (80)
    Call PVWaterJacket2.SetPosition ("On")
    Call PVWaterJacket2.SetTemp (30,1)
    Call PVHopper.SetPosition ("Open")
    Call MVAgitator1.SetPosition ("On")
    Call MVWaterJacket1.SetPosition ("On")
    Call MVWaterJacket1.SetTemp (58,1)
  End If
  If MVWaterJacket1.Temp >= 58 And PVAgitator2.RPM >= 80 Then binGoOn = TRUE
  If not binGoOn Then
    Call Sleep( 1000 )
    RunTime.RecipeStepTime = RunTime.RecipeStepTime + 1000
    RunTime.RecipeTotalTime = RunTime.RecipeTotalTime + 1000
  End If
  If RunTime.RecipeStepTime >= 60000 Then binGoOn = True
  binRunLoop = False
Loop While Not binGoOn
```

Mode HMI

Run Recipe

Run Recipe Step

Stop Recipe

Continue Recipe

Cancel/Reset Recipe

Start Data Collector

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Fig. 24

| Item | Value |
|-------------------------------|-------|
| MBC.PVAgitator2.SpeedSetPoint | 0 |
| MBC.PVAgitator2.RPM | 0 |
| MBC.PVAir.OnSetPoint | 0 |

Watch1 Watch2 Debug

Fig. 25

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DataCollector

Stats

File: Time:

Date

| ID | Name | Type | R/W | Value |
|----|---------------------------------------|---------|-----|----------|
| 1 | RecipeInterface.RunTime.RecipeStepIdx | Integer | R | 0 |
| 2 | MBC.PVAgitator2.SpeedSetPoint | Double | R | 0 |
| 3 | MBC.PVAgitator2.RPM | Double | R | 0.000000 |
| 4 | MBC.PVWaterJacket2.TempSetPoint | Double | R | 0 |
| 5 | MBC.PVWaterJacket2.Temp | Double | R | 0.000000 |
| 6 | MBC.PVDrain2.IsOpen | Boolean | R | False |
| 7 | MBC.PVHopper.IsOpen | Boolean | R | False |
| 8 | MBC.PVDisolverFeed.FlowRateSetPoint | Double | R | 0 |
| 9 | MBC.PVDisolverFeed.FlowRate | Double | R | 0.000000 |

Storage

Time (ms) File

Fig. 26

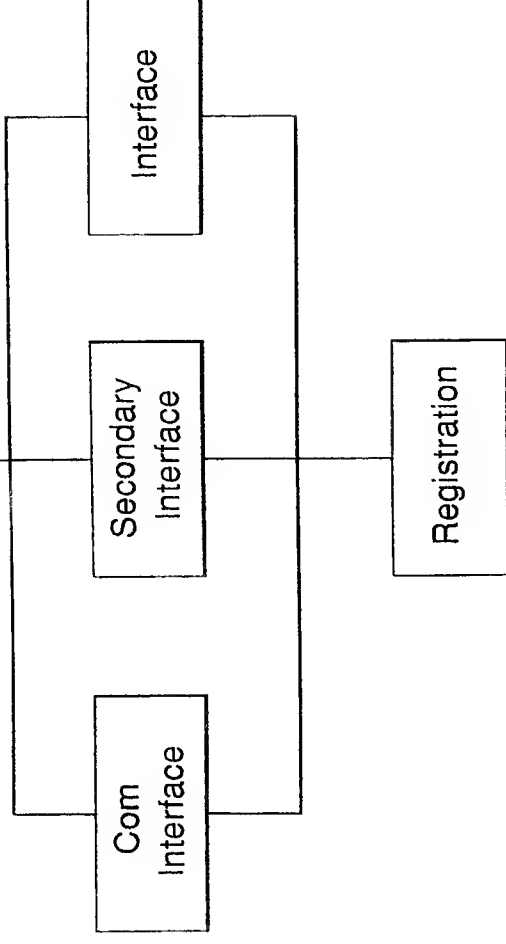


Fig. 27

| Library | Component |
|-----------------|--------------------|
| MBC | PVAgitator2 |
| MBC | PVWaterJacket2 |
| MBC | PVDrain2 |
| MBC | PVWaterFeed |
| MBC | PVHopper |
| MBC | PVDecant |
| MBC | PVDisolverFeed |
| MBC | PVFlush |
| MBC | MVAgitator1 |
| MBC | MVWaterJacket1 |
| MBC | PVExhaust |
| MBC | PVPlasmasol |
| MBC | PVAir |
| MBC | PVVacuum |
| MBC | PVCirculatingWater |
| MBC | PVAcetoneDosing |
| MBC | MVAir |
| MBC | MVHotWater |
| MBC | PVLasentec |
| MBC | OPCModel |
| MBC | OPCRuntime |
| Recipeinterface | RunTime |
| Model | TBD |

Fig. 28

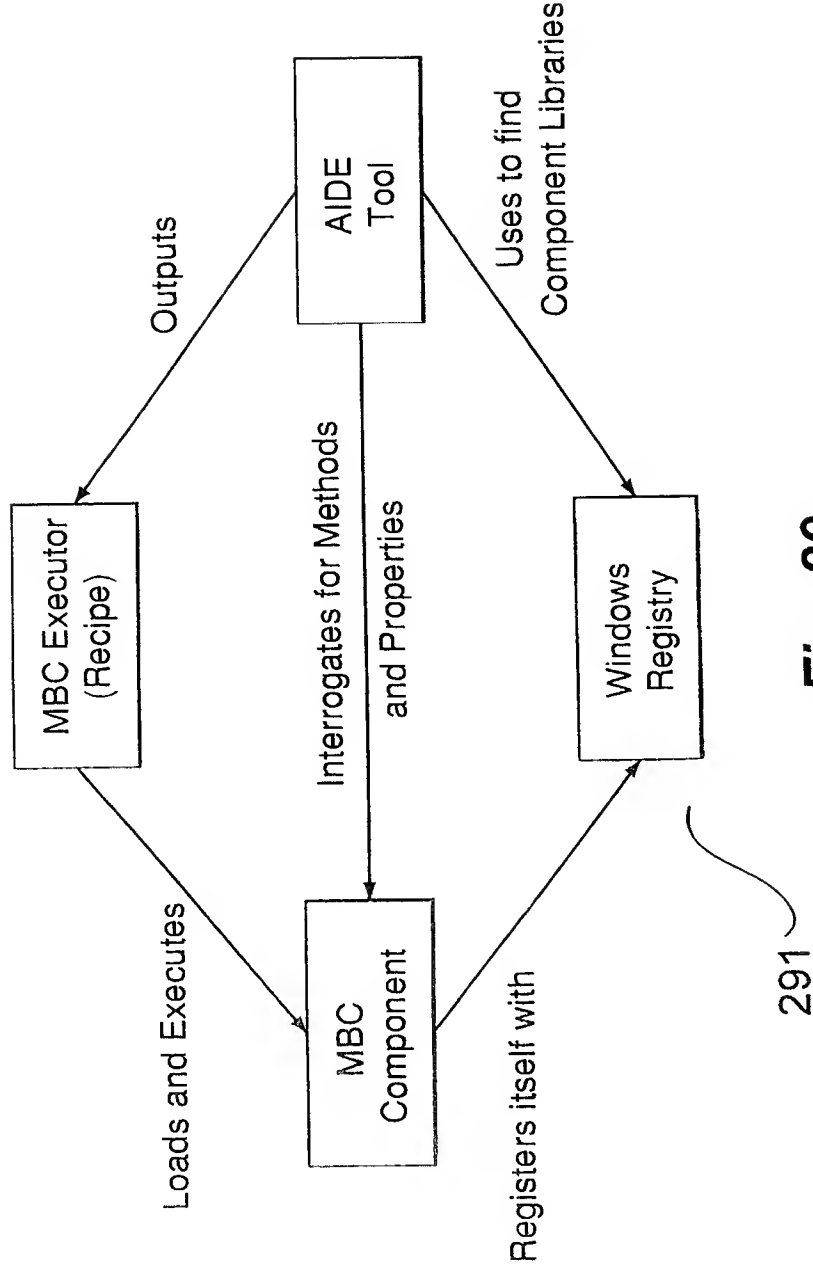


Fig. 29

Fig. 30

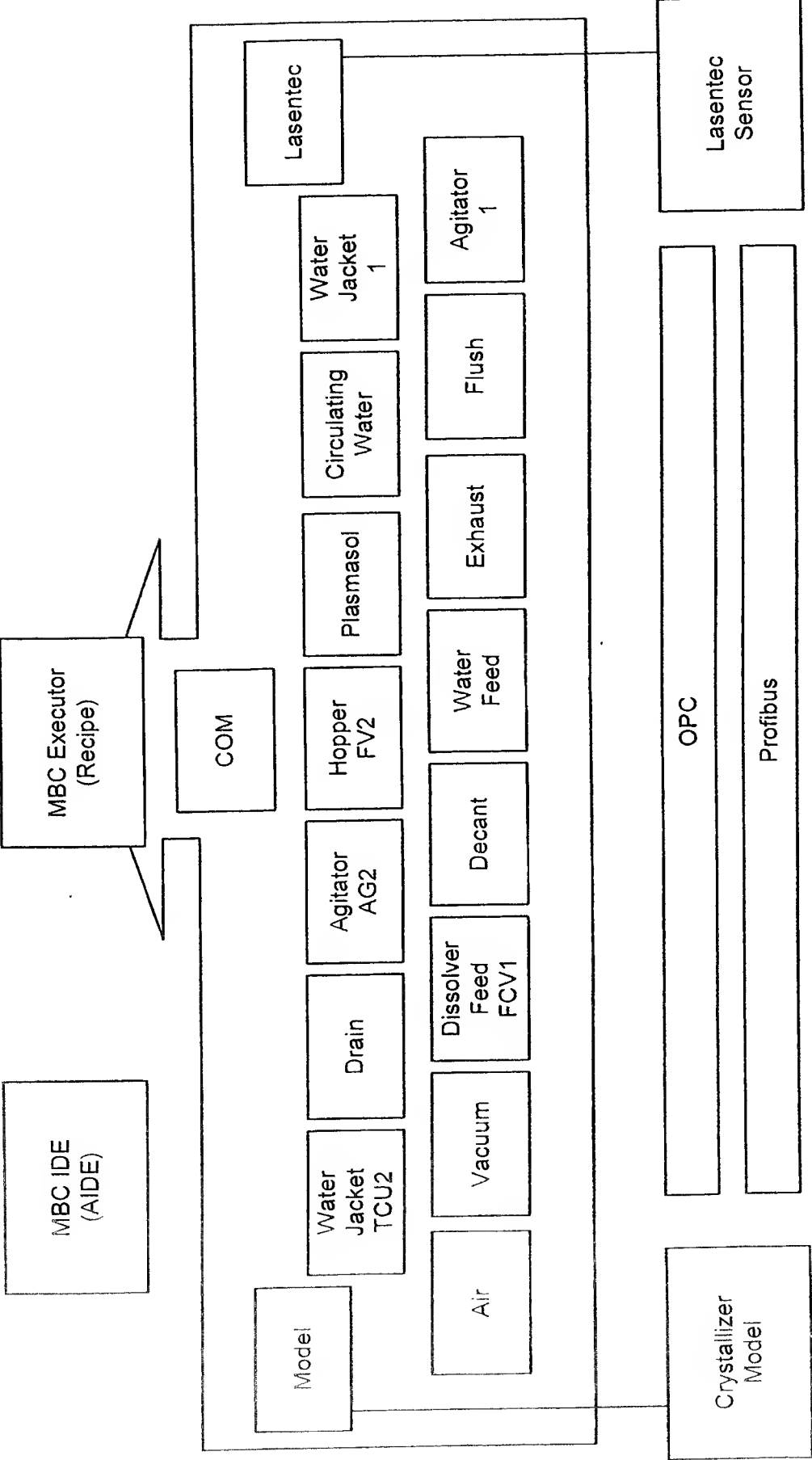


Fig. 31

311

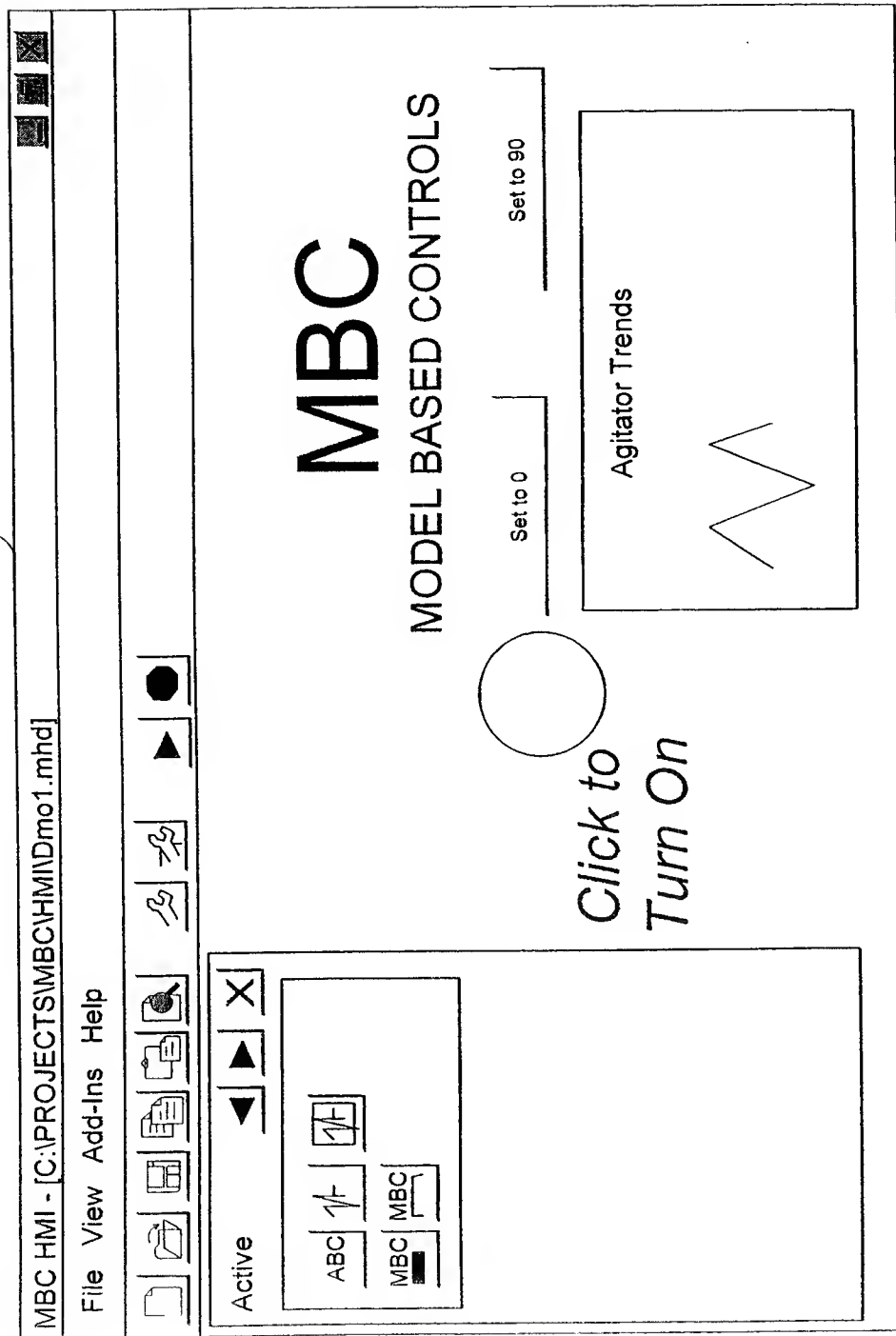
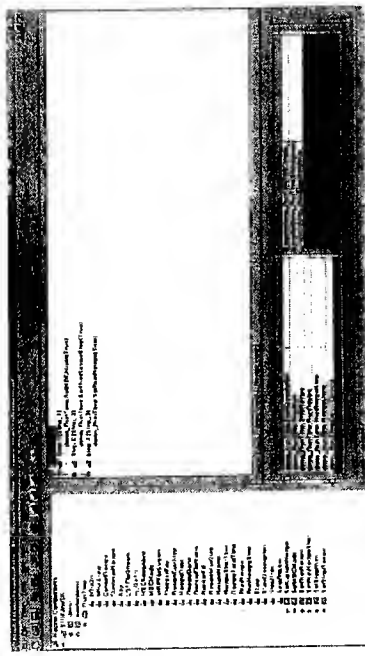


Fig. 32



323

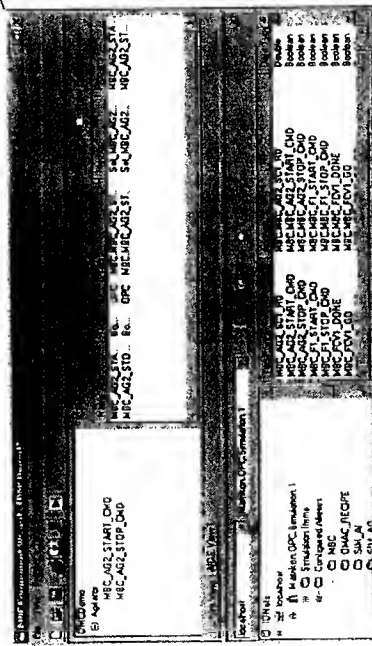
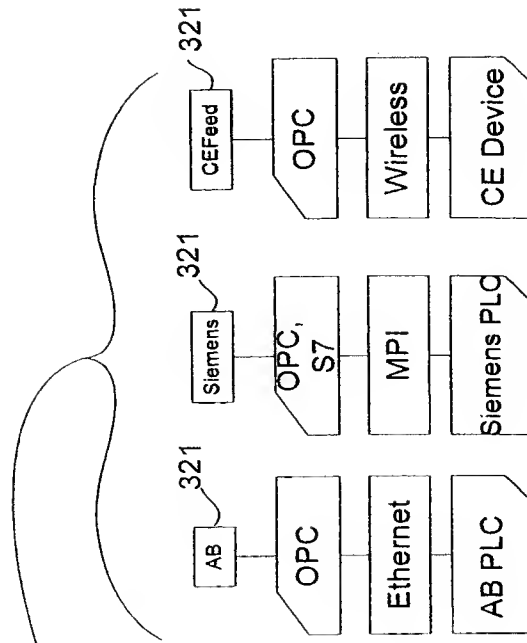
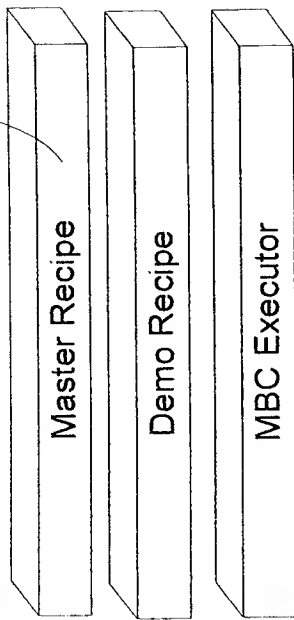
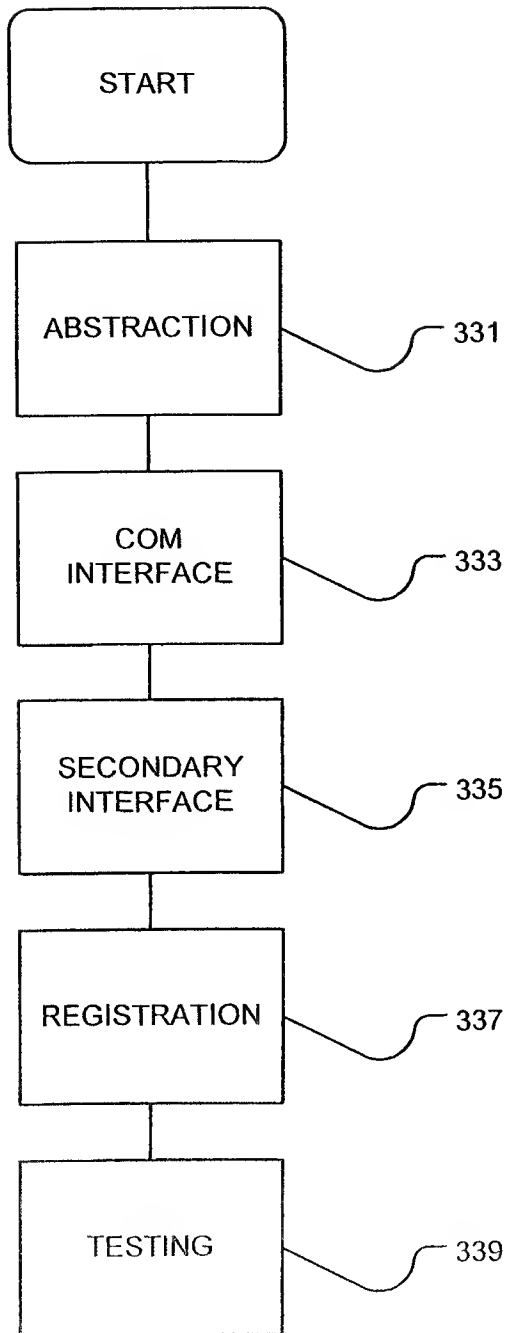


Fig. 33



| IComponent |
|--|
| <ul style="list-style-type: none">◆ ComponentName : String◆ IOPointList : Collection◆ State : Integer◆ StateName ; String |
| <ul style="list-style-type: none">◆ SaveConfig()◆ LoadConfig()◆ ValidateCommand()◆ Initialize()◆ Reset() |

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Fig. 34

| clsIOPoint |
|--|
| <ul style="list-style-type: none"> ◆ Component : String ◆ Name : String ◆ IOType : String ◆ Tag : String ◆ Handle : Long ◆ Value : Variant ◆ Quality : Long ◆ TimeStamp : Long ◆ ValueRange : String ◆ InitialValve : Variant ◆ CanInitiate : Boolean ◆ ScaleFactor : Double ◆ Threshold : Long |
| <ul style="list-style-type: none"> ◆ Equals() : Long ◆ IsEqual() : Boolean |

351

Fig. 35

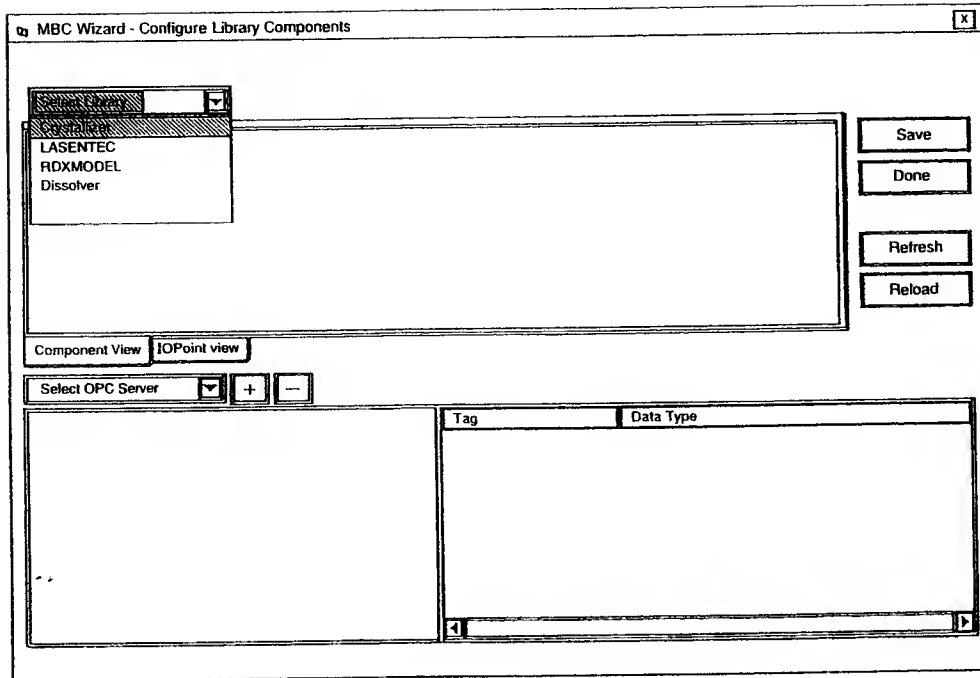


Fig. 36

371

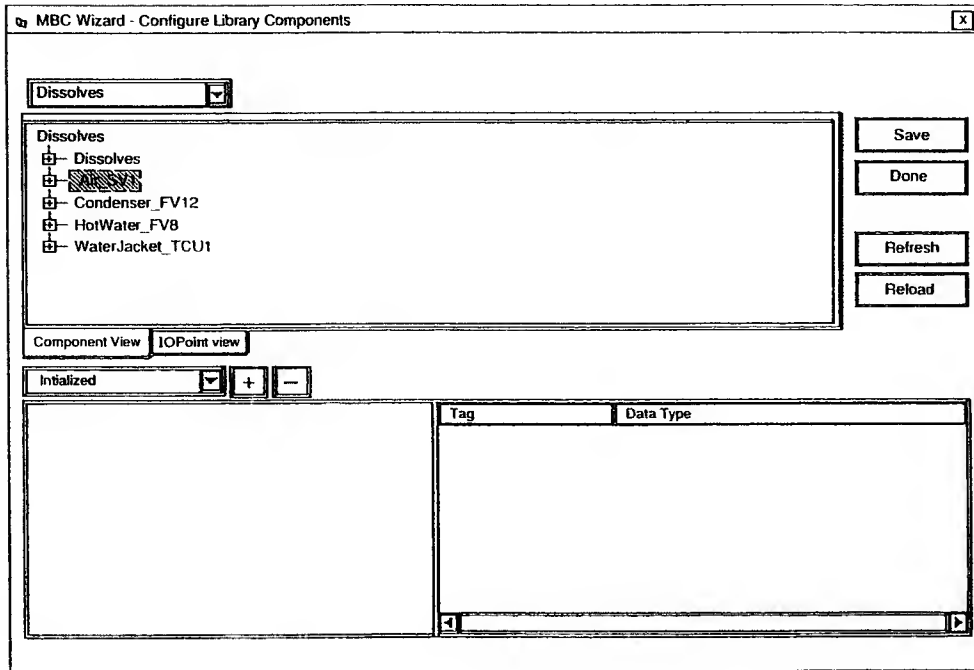


Fig. 37

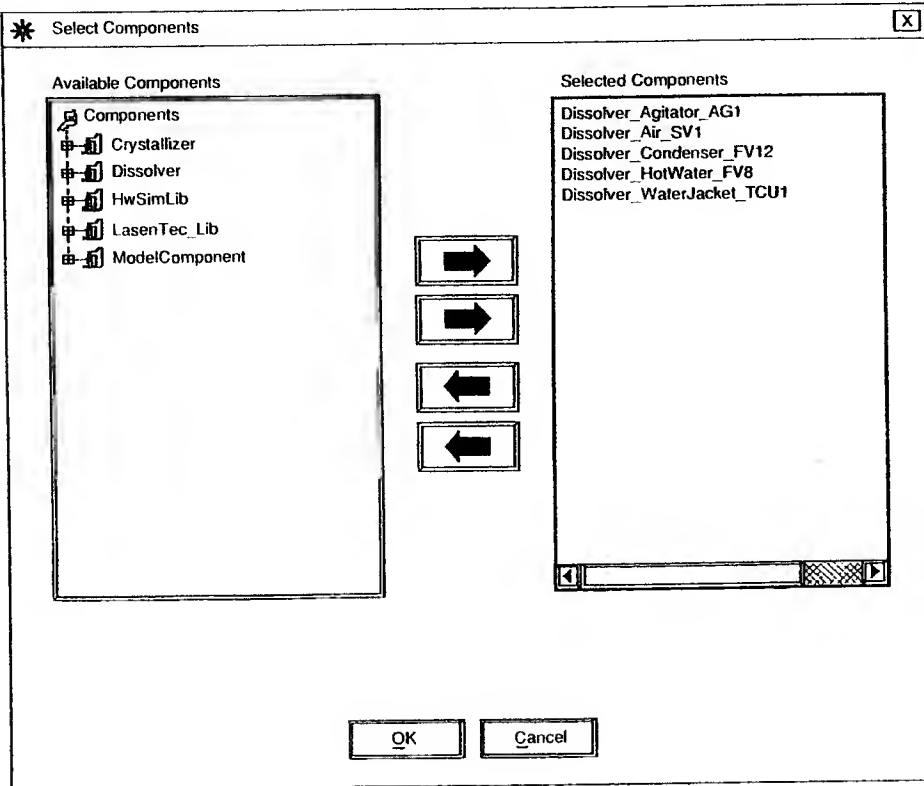


Fig. 38

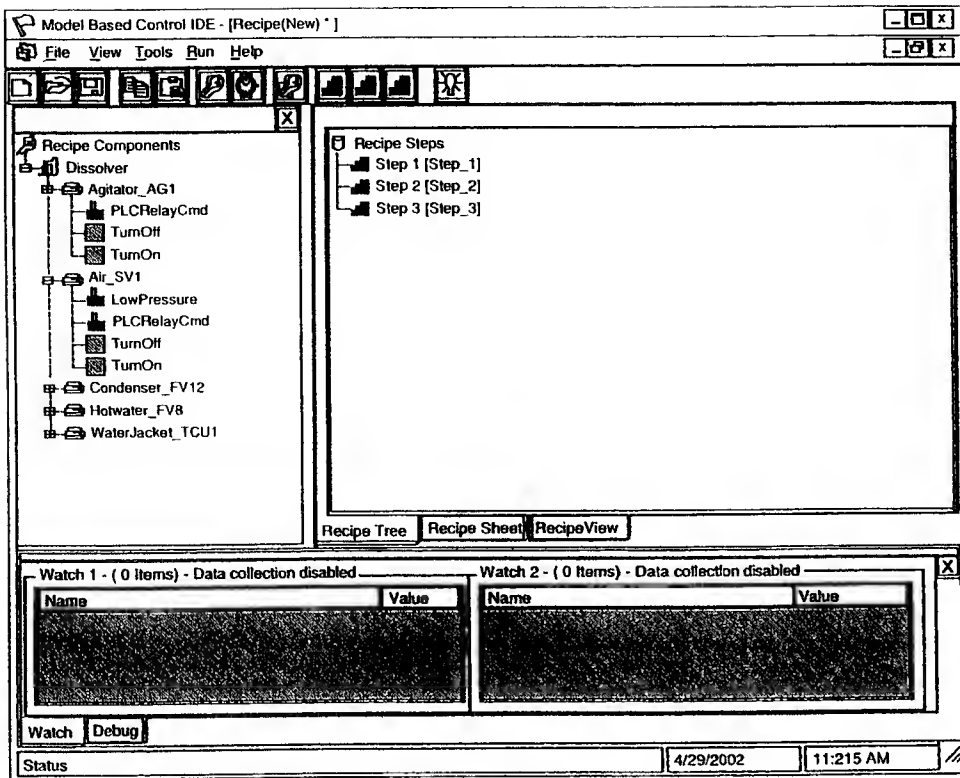
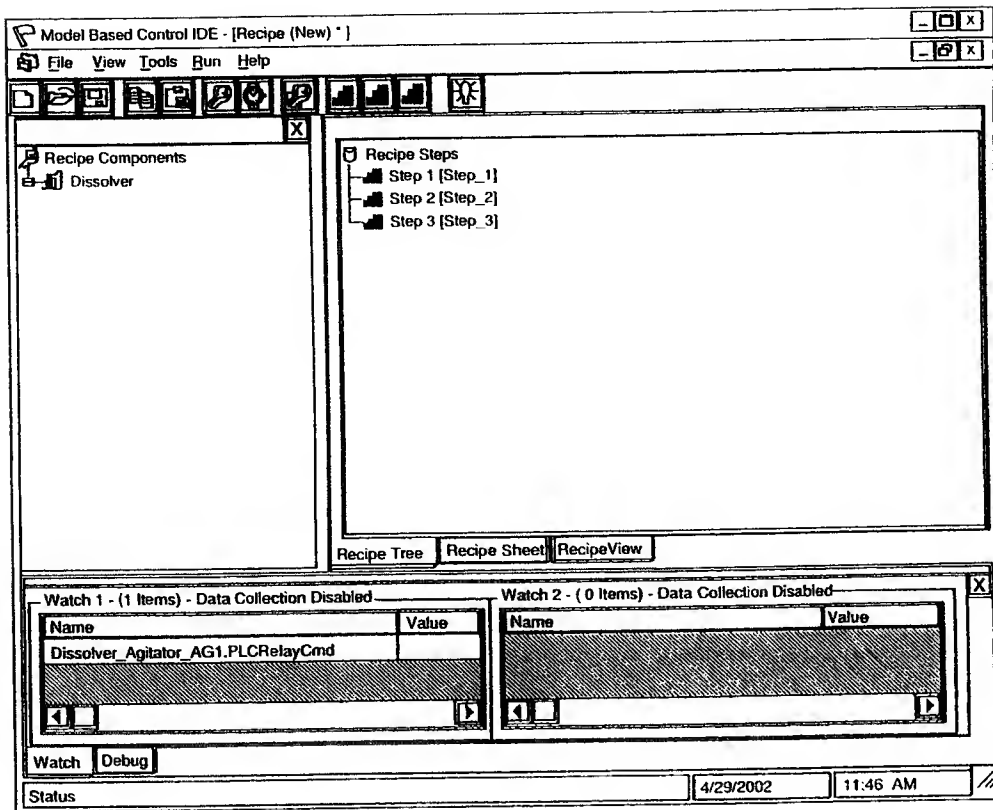


Fig. 39

*Fig. 40*

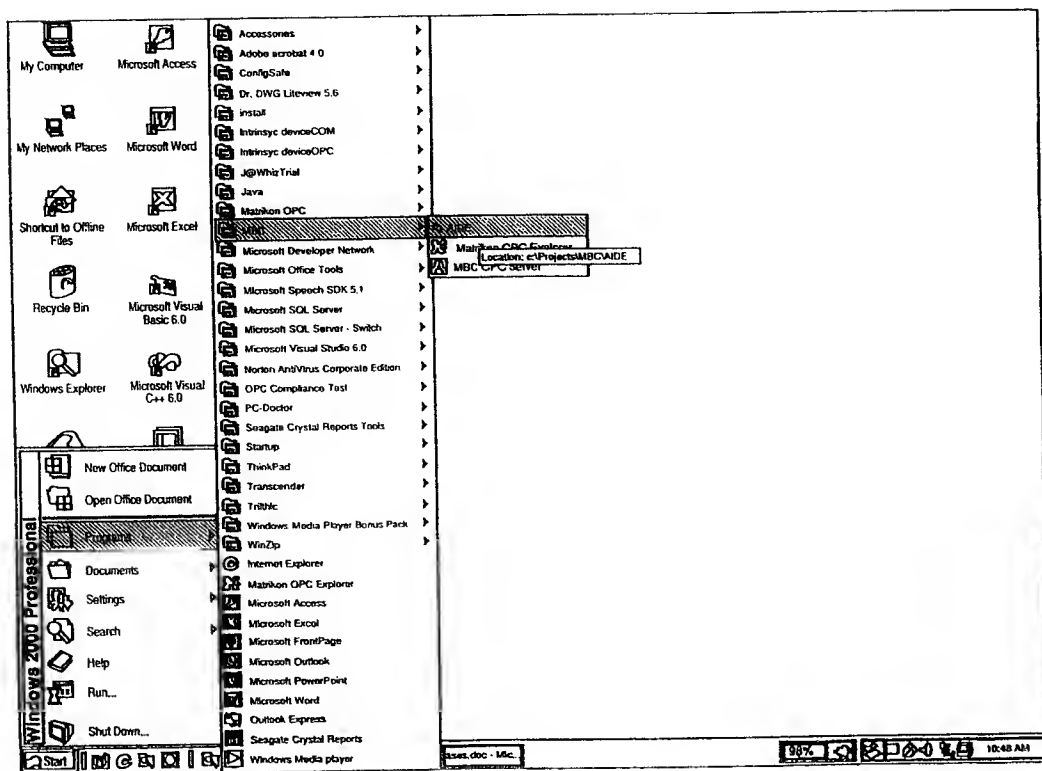


Fig. 41

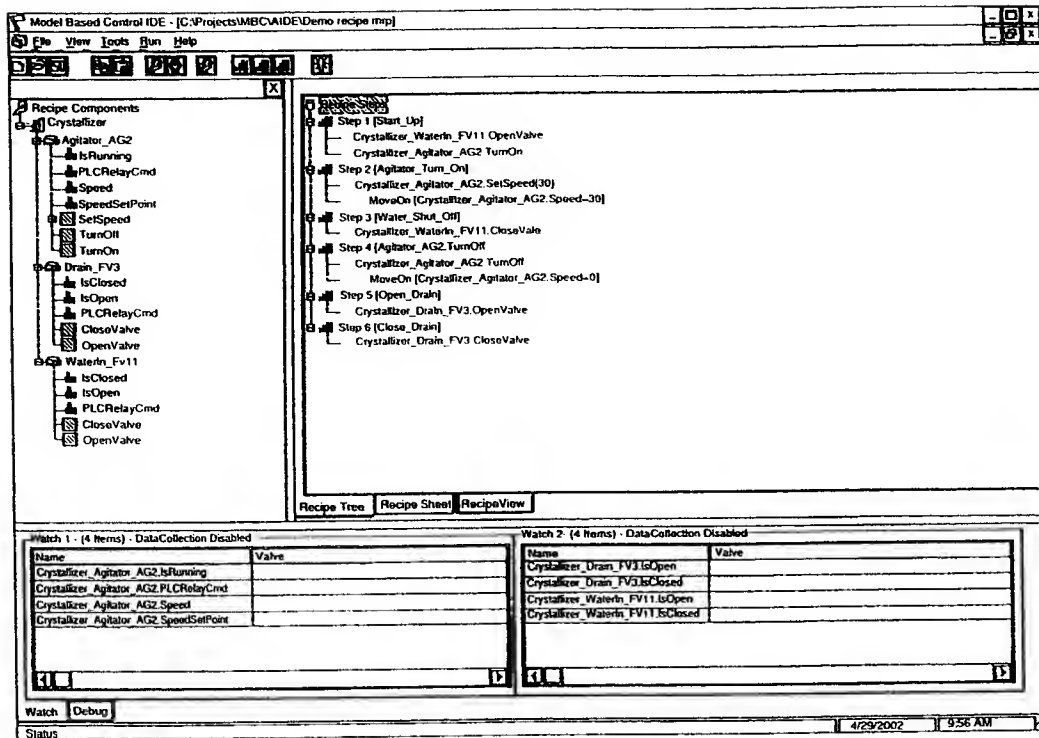


Fig. 42

431

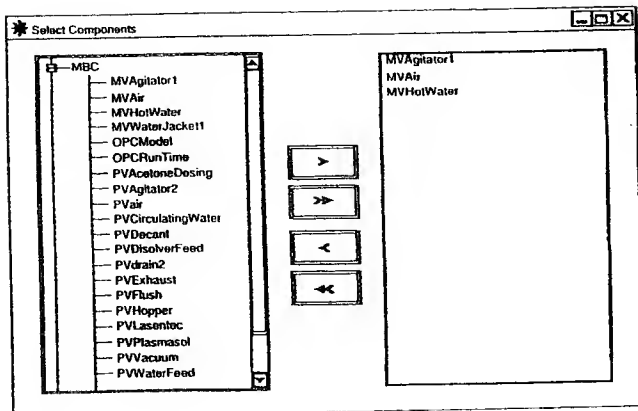
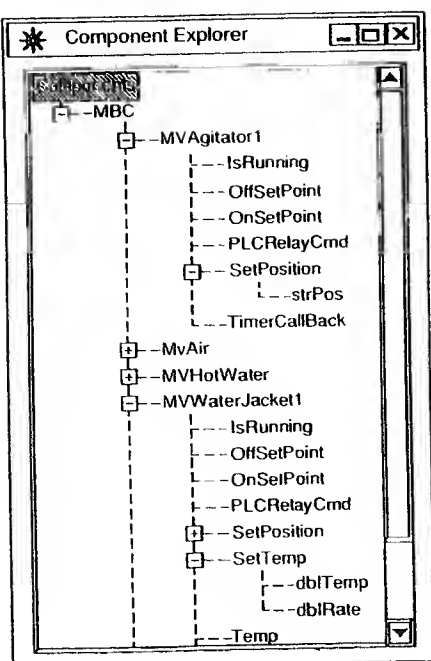
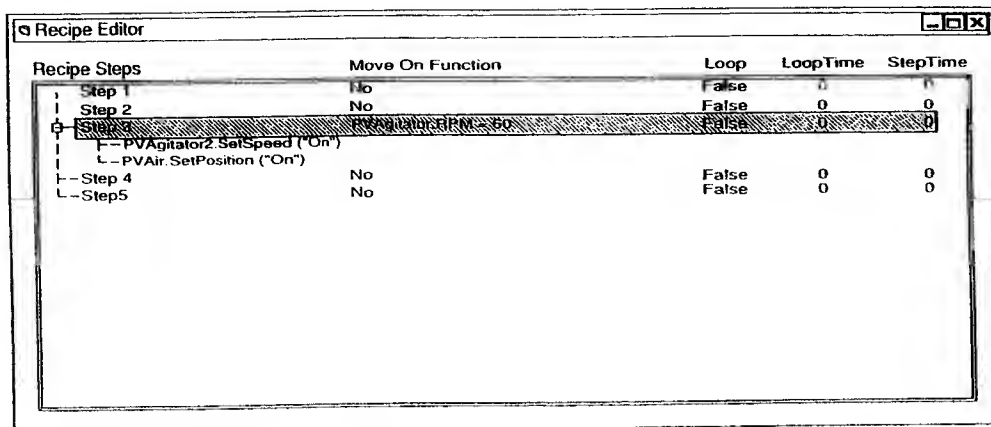


Fig. 43



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Fig. 44



The image shows a 'Recipe Editor' window. On the left is a tree view with the following structure:

- Step 1
 - Step 2
 - Step 3
 - PVAgitator2.SetSpeed ("On")
 - PVAir.SetPosition ("On")
- Step 4
- Step 5

The main table has the following columns: Recipe Steps, Move On Function, Loop, LoopTime, and StepTime. The data is as follows:

| Recipe Steps | Move On Function | Loop | LoopTime | StepTime |
|--------------|----------------------|-------|----------|----------|
| Step 1 | No | False | 0 | 0 |
| Step 2 | No | False | 0 | 0 |
| Step 3 | PVAgitator2.RPM = 50 | False | 0 | 0 |
| Step 4 | No | False | 0 | 0 |
| Step 5 | No | False | 0 | 0 |

Fig. 45

Recipe Step Detail

Step No: Description:

☐ Pre-Process Step

☐ Post-Process Step

Component Commands

MBC.PVAgitator.SetPosition("ON")

MBC.PVAgitator.SetSpeed(60)

MBC.PVAir.SetPosition("Open")

Loop Control

Move On:

Loop Time:

Step Time: Units:

Fig. 46

Fig. 47

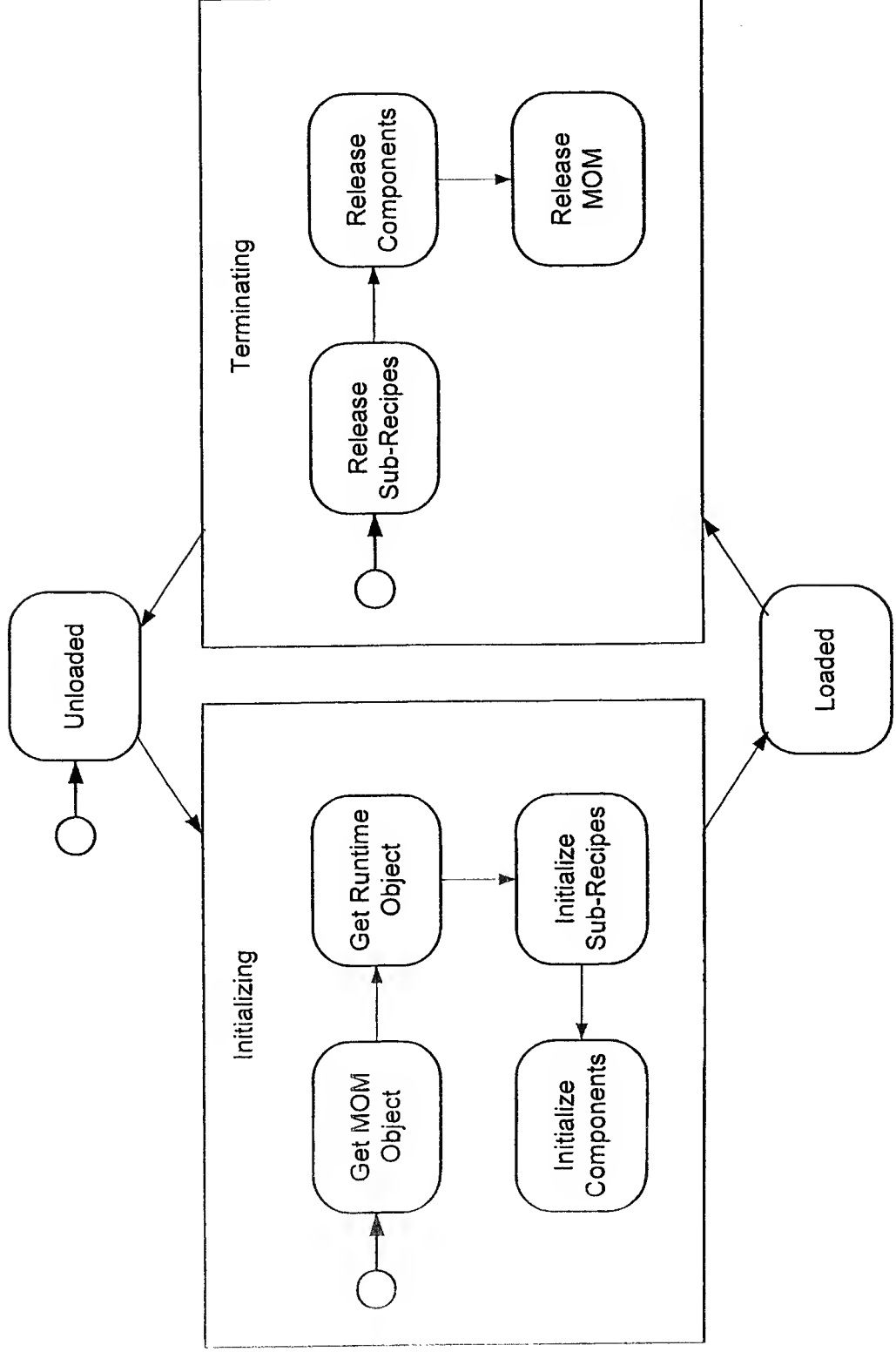


Fig. 48

Loaded

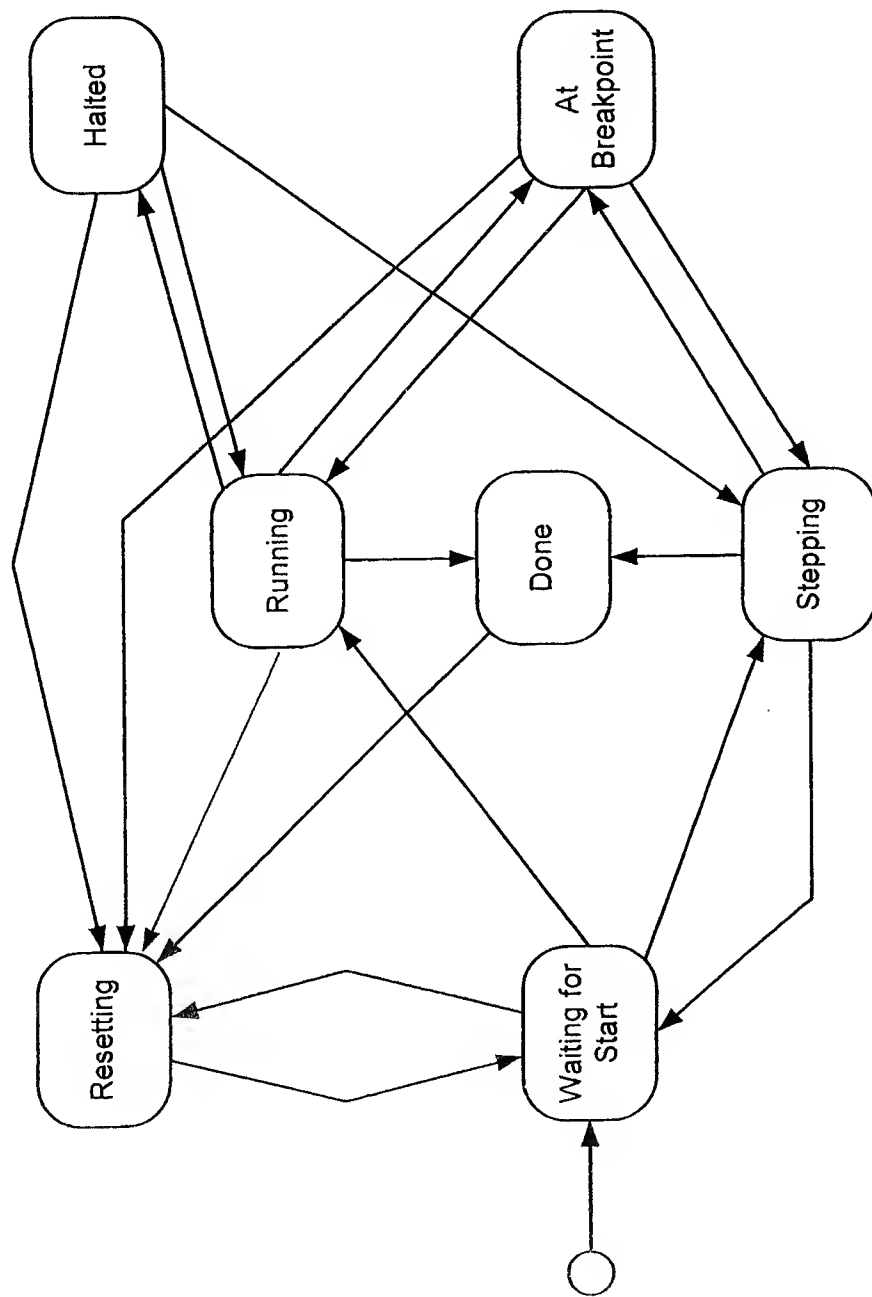
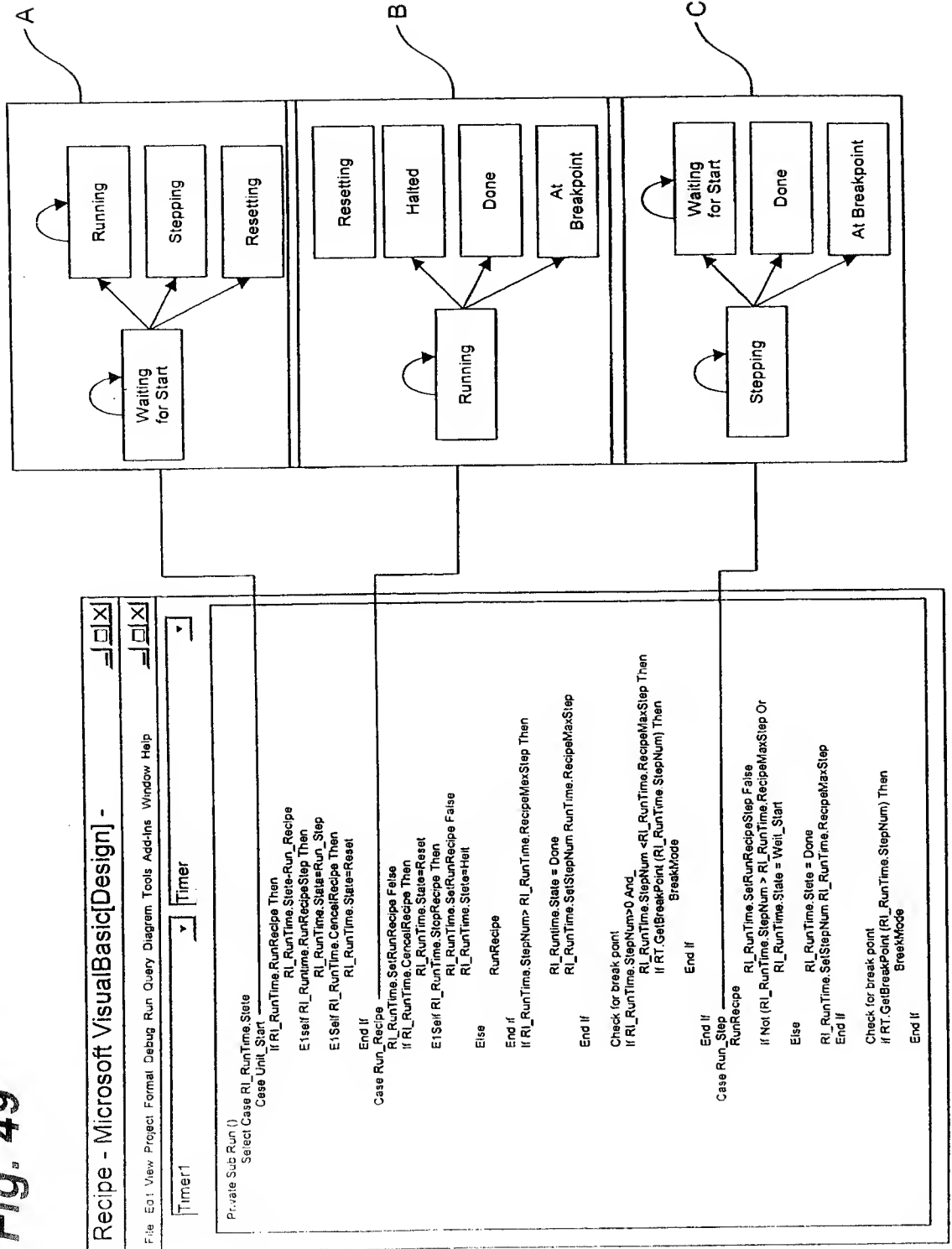


Fig. 49



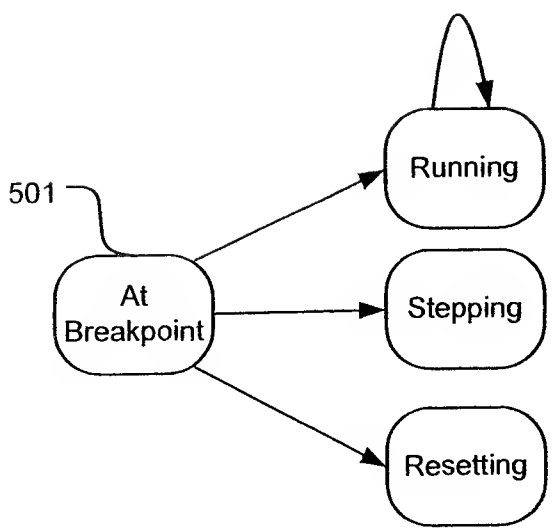


Fig. 50

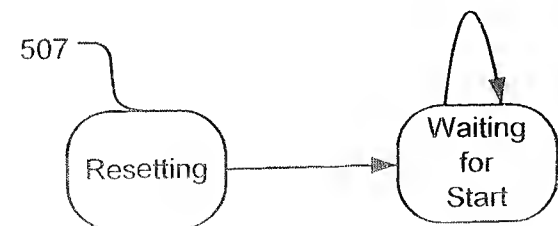
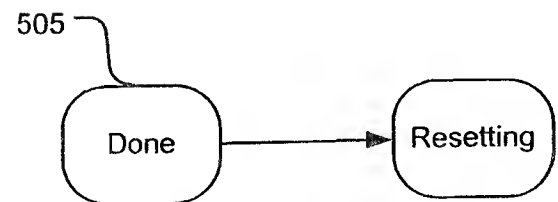
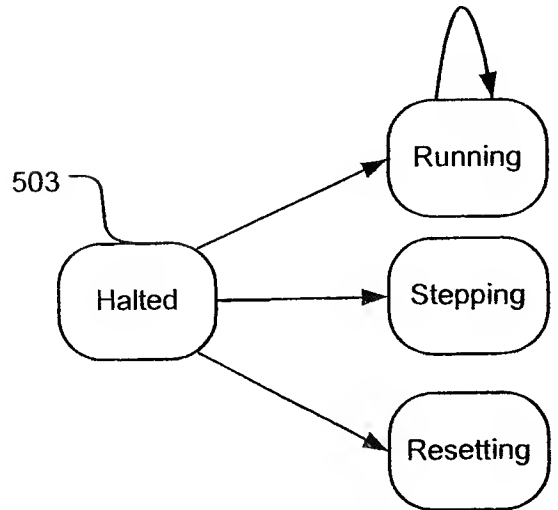
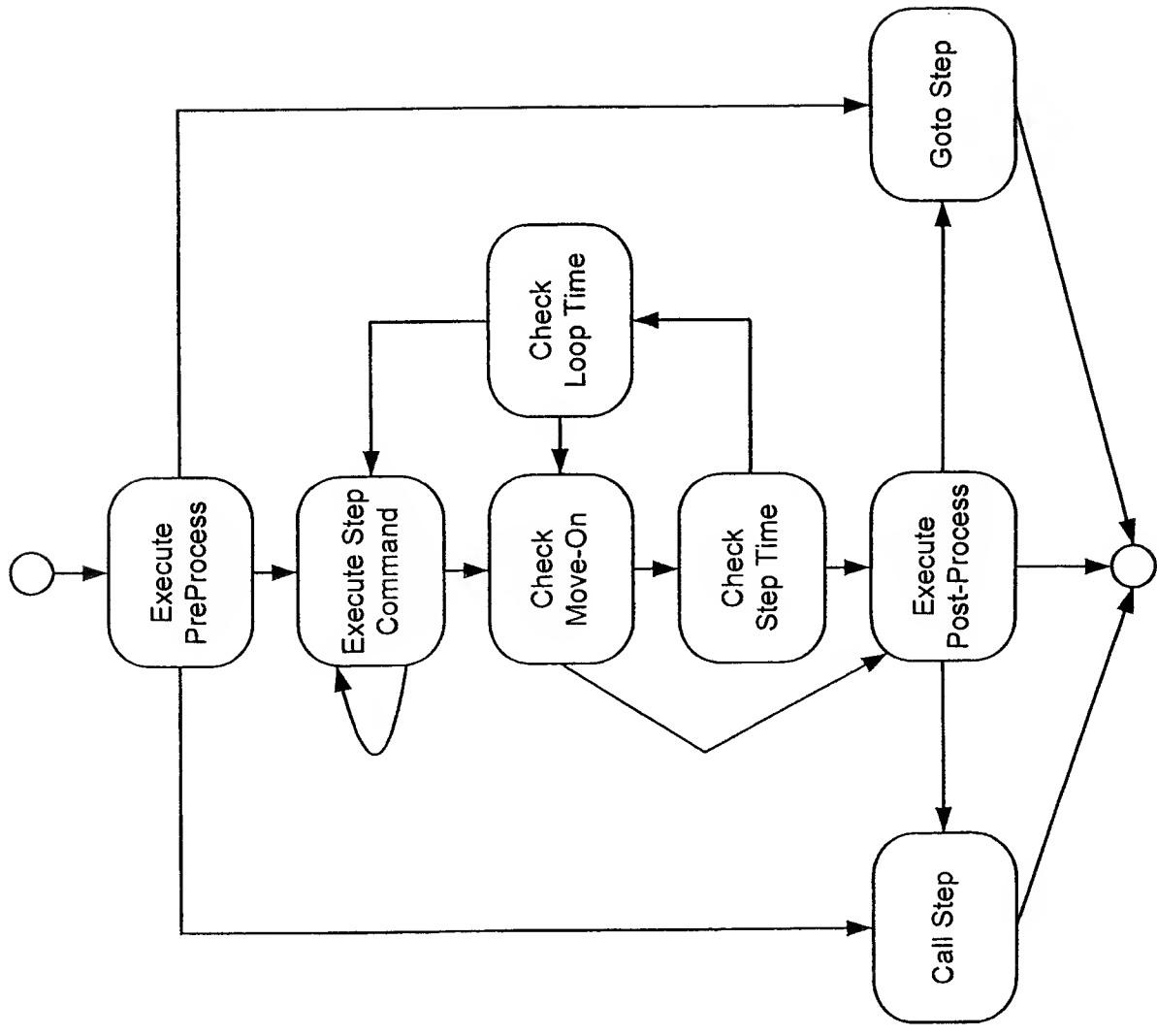


Fig. 51



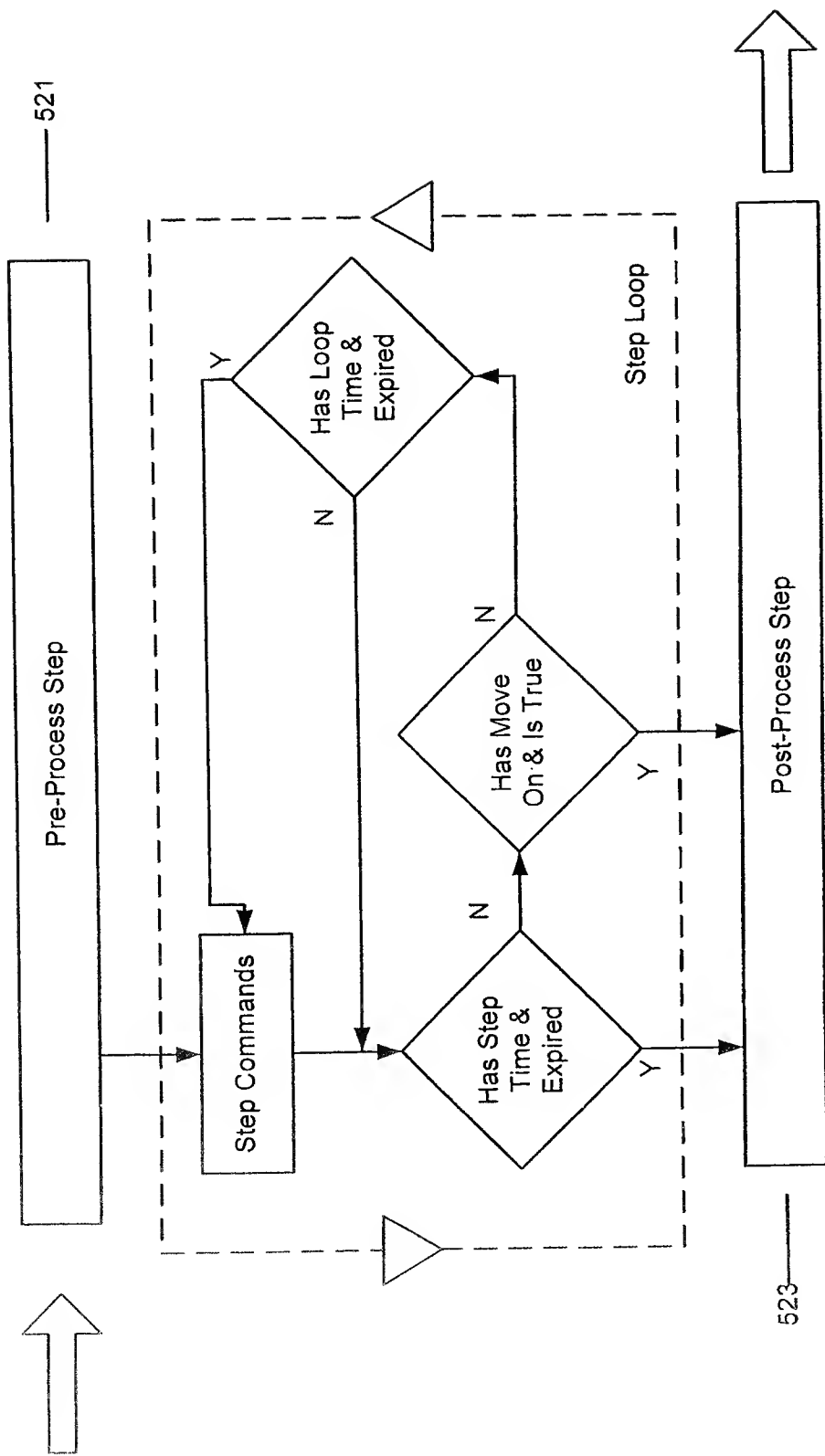


Fig. 52

Figure 1: Recipe Step Detail

The diagram illustrates the layout of a 'Recipe Step Detail' window. The window has a title bar with a close button (X). The main content area is organized as follows:

- Step No.:** A text box containing the value '1'.
- Name:** A text box containing the value 'Step_1'.
- Description:** A large text area for describing the step.
- Pre Process:** A section containing a conditional command block:


```
If M_Mike_LAPTOP_Crystallizer_Drain_FV3.IsOpen Then
  GotoStep "Step_2"
EndIf
```

 An 'EXP' button is located to the right of this block.
- Post Process:** A section containing another conditional command block:


```
If M_Mike_LAPTOP_Crystallizer_Drain_FV3.IsClosed Then
  GotoStep "Step_3"
EndIf
```

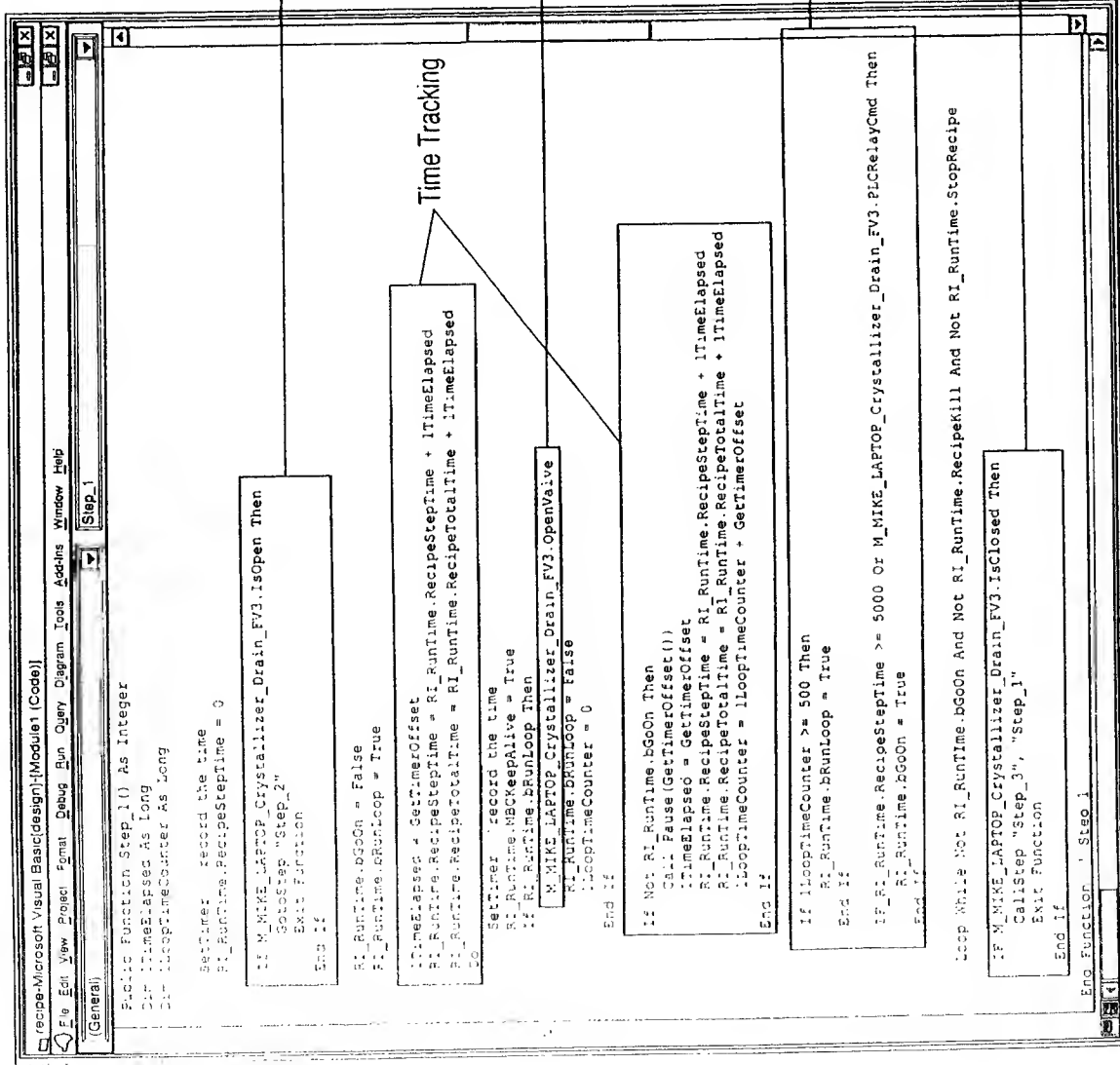
 An 'EXP' button is located to the right of this block.
- Component Commands:** A list box containing the command 'M_Mike_LAPTOP_Crystallizer_dra'. Above the list box are four navigation buttons: up arrow, down arrow, plus, and minus.
- Loop Control:** A section containing:
 - A 'Move On' button.
 - A 'Loop Time' text box with the value '500' and a 'Units' dropdown menu set to 'msec'.
 - A 'Step Time' text box with the value '5000' and a 'Units' dropdown menu set to 'msec'.

At the bottom of the window, there is a row of buttons: 'OK', 'Apply', 'Cancel', 'First', 'Prev', 'Next', and 'Last'.

Reference numerals point to specific elements:

- 531: Points to the 'Pre Process' section.
- 533: Points to the 'Post Process' section.
- 535: Points to the 'EXP' button next to the 'Pre Process' block.
- 537: Points to the 'Step Time' text box.
- 538: Points to the 'Loop Control' section.
- 539: Points to the 'Component Commands' list box.

Fig. 54



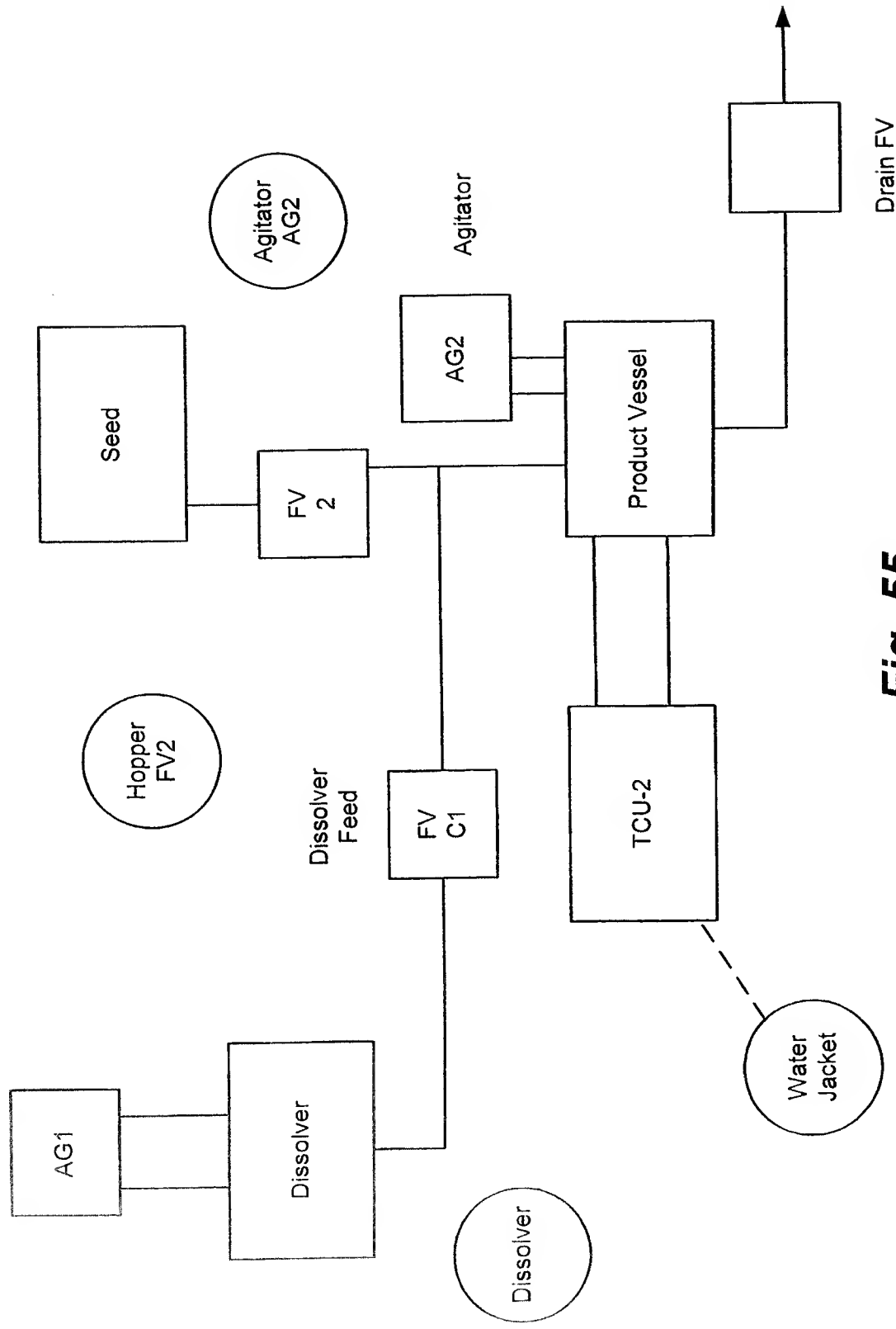


Fig. 55

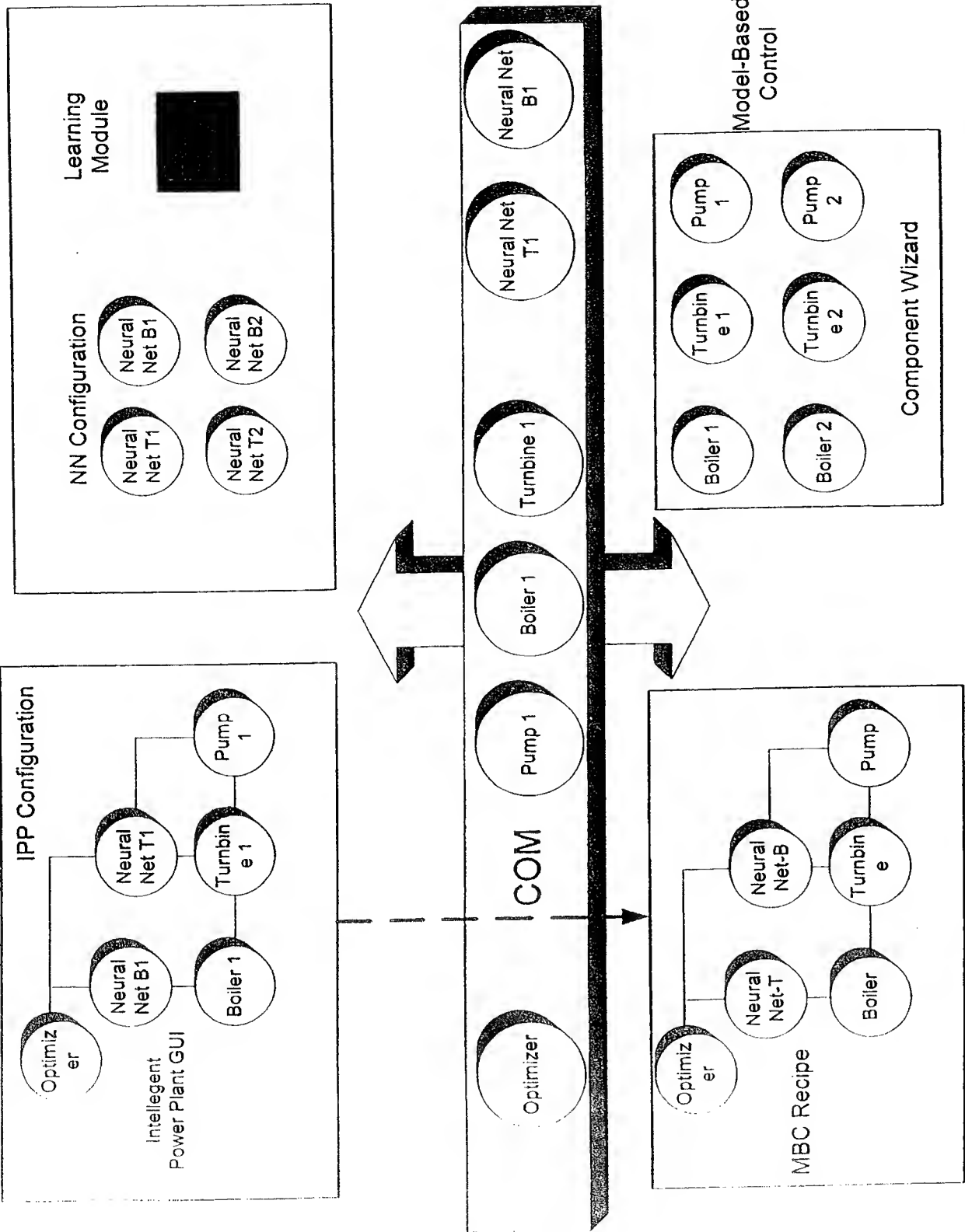


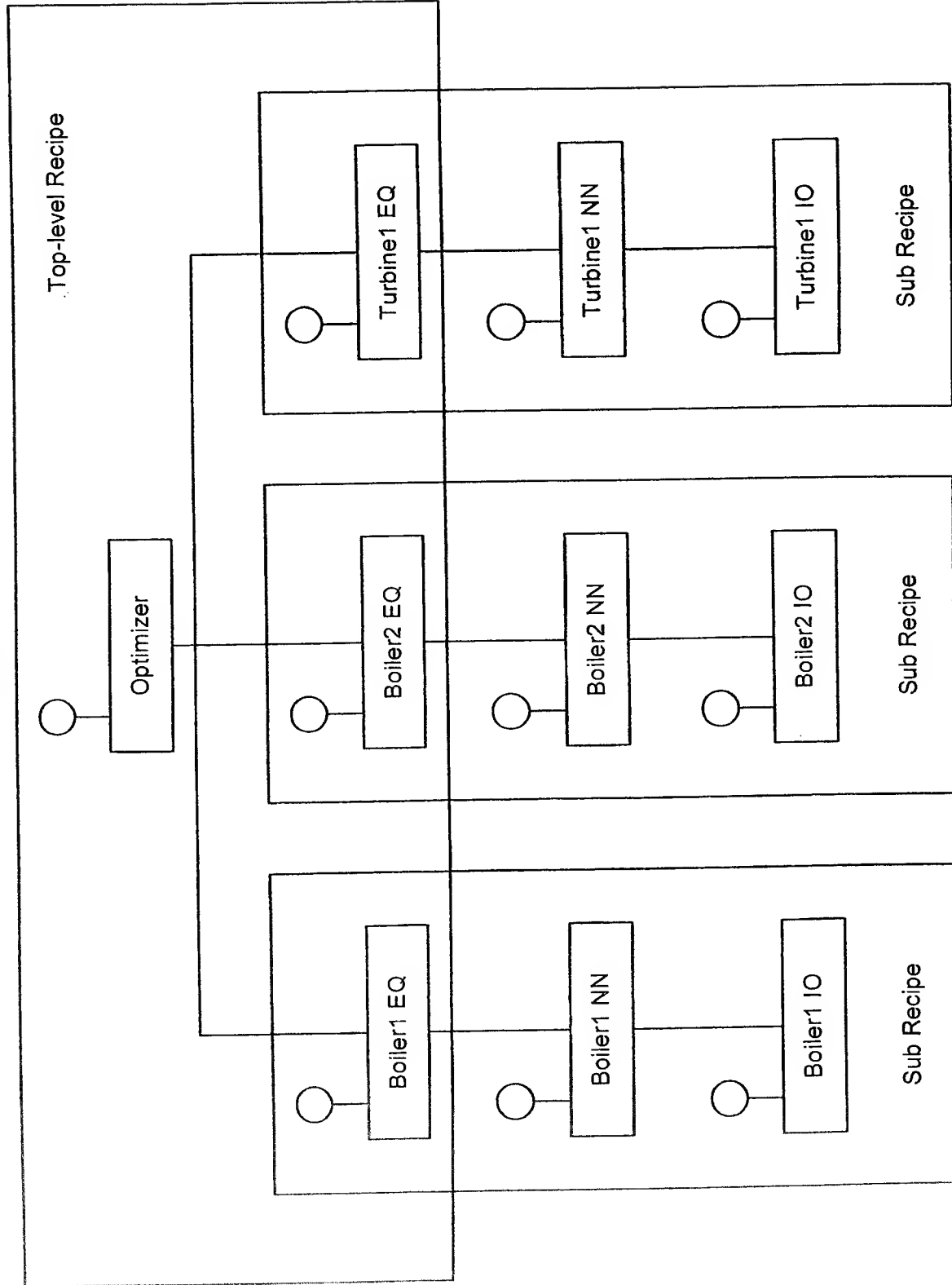
Fig. 56

Power Plant



Mode MBC A1 Step 2 - Running

Fig. 58



MBC DC IOMServer Control Panel

DC IOMServer Configuration File

C:\Projects\Testbeds\MBCDCSim Testbed\MBCDCSim.exe.config

Data Collection File

C:\Projects\Testbeds\MBCDCSim Testbed\MBCDCSim\dctestfile.csv

Mode Interval State Step

Auto 500 Running 9

Auto Manual Load Unload Step Run Stop Reset

Data Collection Items

| RecipeInterf | RecipeInterf | RecipeInterf | RecipeInterf | AtrainData | AtrainData | AtrainData | AtrainData | AtrainData | AtrainData |
|--------------|--------------|--------------|--------------|------------|------------|------------|------------|------------|------------|
| RunTime | RunTime | RunTime | RunTime | Datum | Datum | Datum | Datum | Datum | Datum |
| StateDescr | RecipeTotal | Recipe Step | StepNum | HOUR | HUMID | SOLAR | TEMP | WBCW | WBE |
| Running | 2434 | 2323 | 2 | 7 | 5.68 | 498.09 | 0 | 0 | |

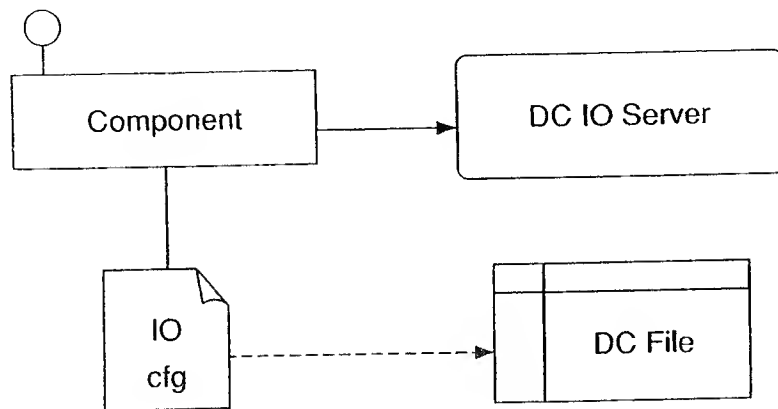


Fig. 59

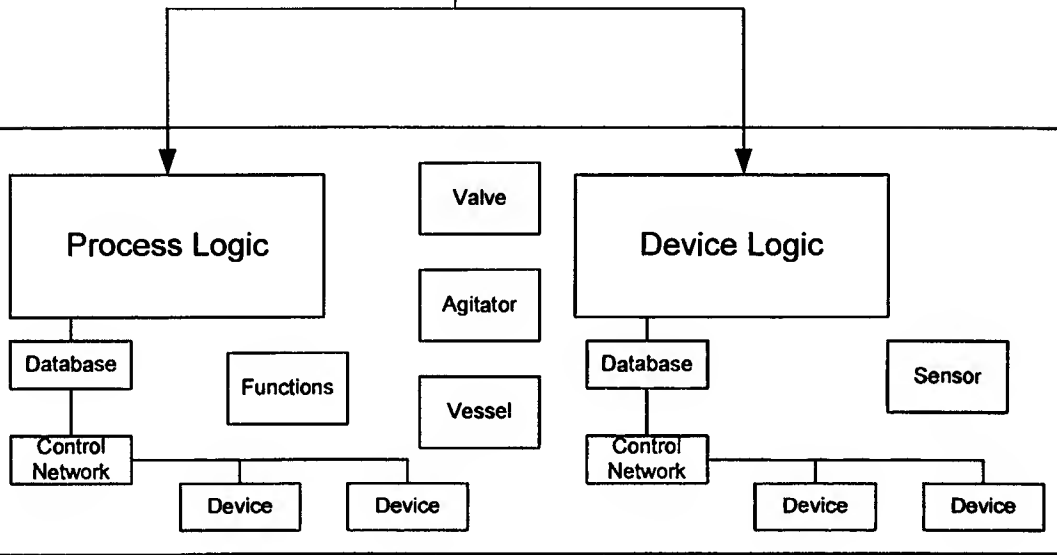
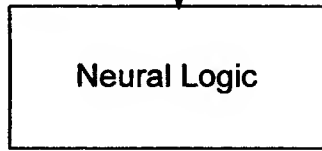
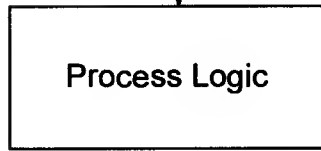
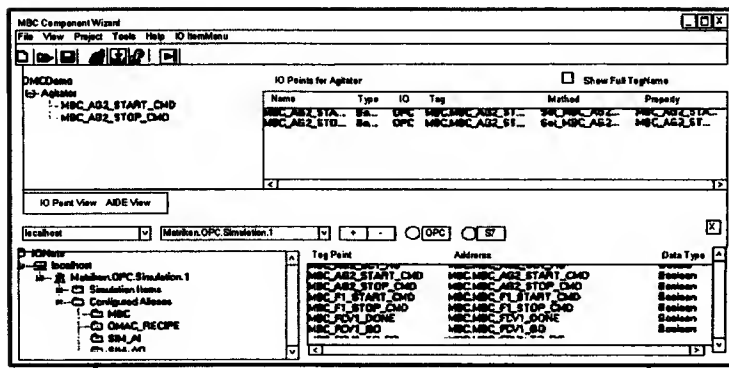
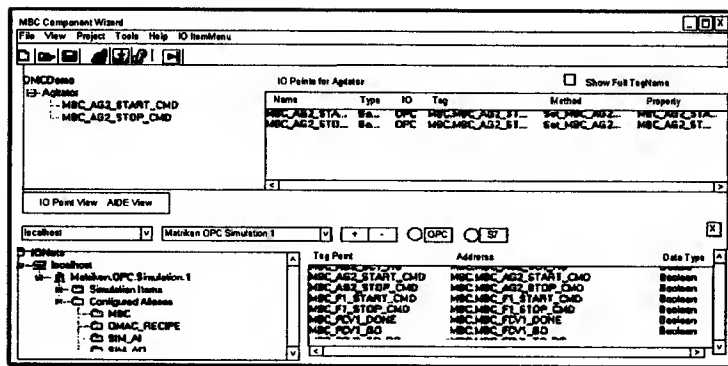


Figure 60



Agitator

Hopper

Exhaust

Agitator

Exhaust

Sensor

Figure 61

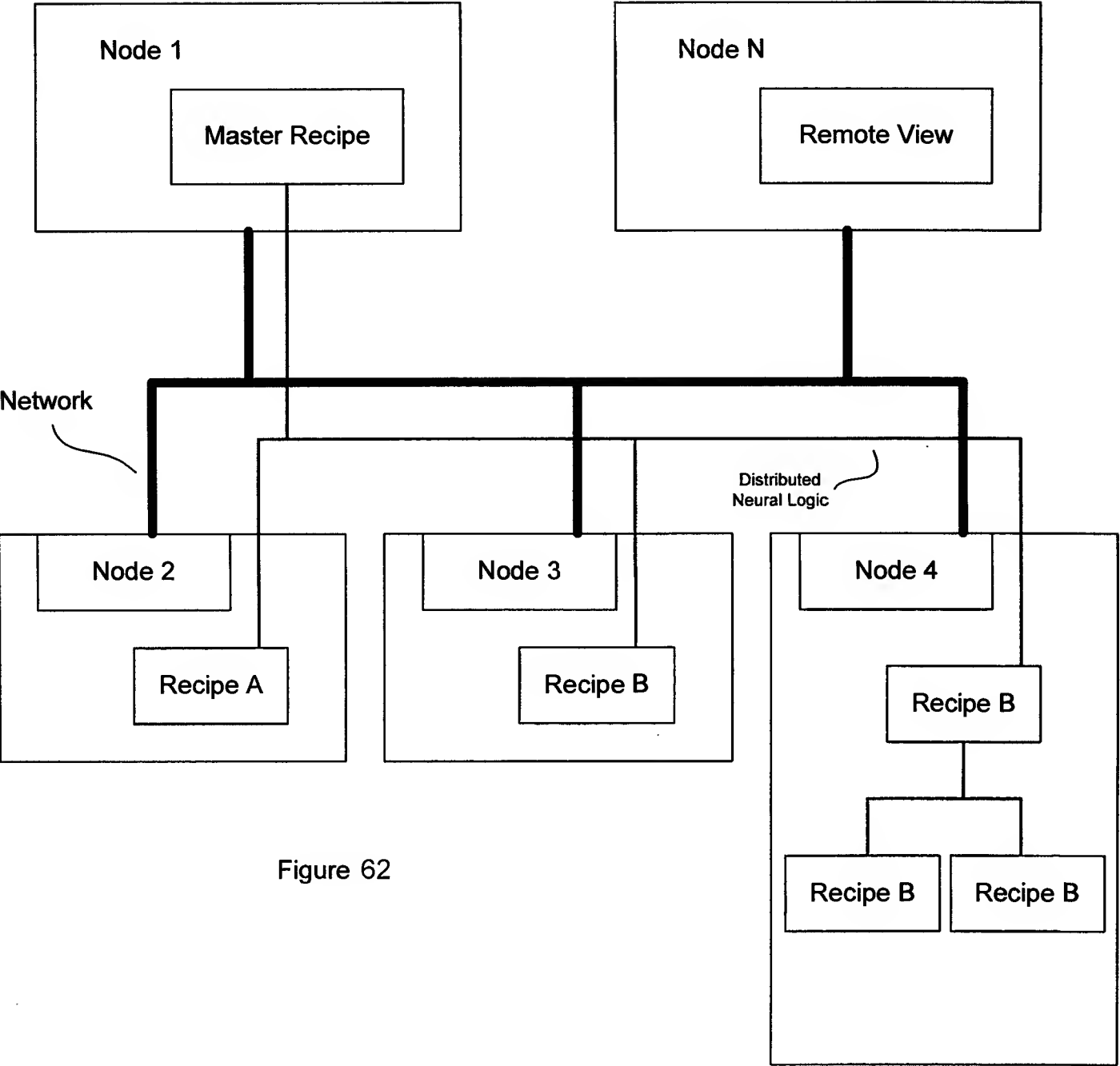


Figure 62